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THE SCHOOL FOR CAPTAINS OF THE MERCANTILE MARINE AT MARSEILLES.

THE Marseilles High School of Commerce has been roused by the difficulty now presented by the recruiting of officers for the mercantile marine, and has just added to its curriculum a course in navigation forming a sort of school apart. Its object is to facilitate access to the career of captain of merchantmen to young men who would thus be able to get a taste of the calling before devoting themselves entirely to it. It will thus offer to the mercantile marine and to companies of navigation a nursery of young men of good education who have already received a certain amount of theoretical and practical special instruction, and is designed to furnish a selection of officers worthy of the important functions that are often confided to them.

It was not till the end of last year that this school was opened, but, despite the small amount of publicity given to its advent, its lecture courses began with an attendance of twenty-five students. The latter are admitted at the ages of from sixteen to twenty-five years, after examination, and pursue theoretical and practical courses in navigation for two years. In their studies they have at their disposal models of improved ships capable of being taken apart, and from which they learn the names and uses of each of the objects that enter into its construction—its hull, masting, etc., and even the various maneuvers that can be made therein (Fig. 3). Besides, they are weekly submitted to a practical drill in ships' boats or on a training sloop in the port or at sea (Figs. 1 and 3).

After this period of two years' instruction, it seems evident that the young men who intend to perform the functions of officers of merchantmen will be better fitted than others to fulfill the necessary conditions. Up to the present, in fact, the career has been accessible only to those who had accomplished sixty months of navigation before any theoretical study. After acquiring sufficient practical instruction during this long period of time spent at sea, they presented themselves at the Hydrographic School, where they obtained the knowledge necessary to perform the functions that they might be called upon to perform, from a maritime as well as a commercial point of view; for the captains of merchantmen have always been potent commercial agents in foreign parts for the owners of their vessels.

Previous to steam navigation, the recruiting of such officers was relatively easy, especially from among pilots' apprentices, lads of from sixteen to seventeen years of age, usually the sons or relatives of captains, having a very decided vocation, and whom the numerous sailing vessels then in use assured an almost certain future. They lived at the captain's table, profited by all the technical conversation that they heard there, went on watch with the officers, and rapidly familiarized themselves with the service at sea. They had a marked advantage over the simple sailor living at the crew's station, who, after the same period of navigation, although capable of pretending to the same claims, was much less fitted for a command. So when the pilot's apprentice was called upon to do his nautical service, he could, after a short time, be appointed an auxiliary midshipman. But, since the advent of steam navigation, as the number of sailing vessels has greatly diminished, the number of officers necessary for commanding them has likewise diminished, and there are no longer any pilots' apprentices or any auxiliary midshipmen.

The recruiting of officers for the mercantile marine could scarcely be done any longer, except from among novices and sailors who had served at least twenty-four years in inferior situations, little in keeping with those that they were to occupy, and who were sometimes also deficient in the preliminary education designed to allow them to enter the Hydrographic School, so the large steam navigation companies accepted the services of officers of the navy who left the government service, in which promotion was becoming too slow, and intrusted them with the command of their large ships. But, while these officers were finding very advantageous situations there, the captains of merchantmen, on the contrary, saw their future shattered, and were but little disposed to advise their sons, or the young men who asked their advice, to engage in a career in which there were no longer any prospects. The result is that the recruiting of subordinate officers, lieutenants or mates, for the mercantile marine is becoming more and more difficult, and the cause of it resides in the difficulties of access and in the decrease of the situations of futurity to which the captains of merchantmen can aspire.

FIG. 2.—ANCHOR AND SAIL PRACTICE ON SHIPS' BOATS.

The difficulties of access have been the same at all times. It was generally believed that it was necessary to begin navigation very early, in order to be able to learn the profession. But this was putting the cart before the horse, for it turned out that, after sailing the seas for quite a long time, the young men did not reunite the conditions of education and theoretical instruction necessary to permit them to present themselves at the examinations for the captaincy of merchantmen.

The Marseilles school, then, is designed to fill this gap. All the other conditions remain the same, but the large navigation companies have pledged themselves to take the diplomated pupils in charge and to complete their practical instruction under conditions perfectly acceptable and conformable to the situation that is to be given future officers. They will ship in the capacity of student officers, and will live with the officers. Their sixty months of navigation will, therefore, be accomplished under excellent conditions, and they will be so much the more apt to profit by all that they see around them, in that their theoretical instruction will have been much advanced by their two preparatory years. When they afterward present themselves at the School of Hydrography, they will stand a good chance of being received there the first year. As a consecration to the efforts made by the Marseilles School of Commerce, it is to be hoped that the new courses that it has just opened will soon be recognized as of public utility. It is to be desired, too, that the young men who attend them may be

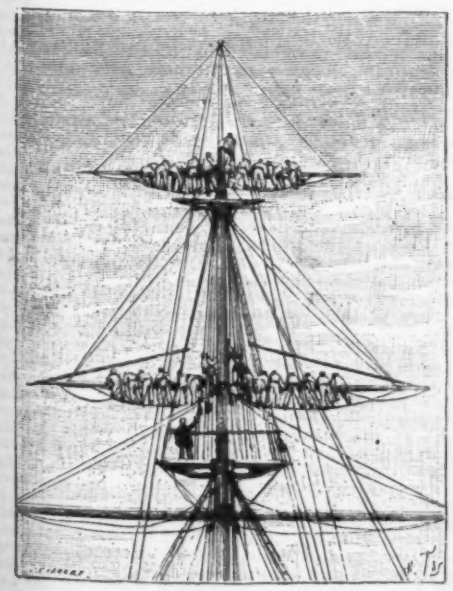


FIG. 1.—STUDENTS OF THE SCHOOL FOR CAPTAINS PRACTICING ON A TRAINING VESSEL.

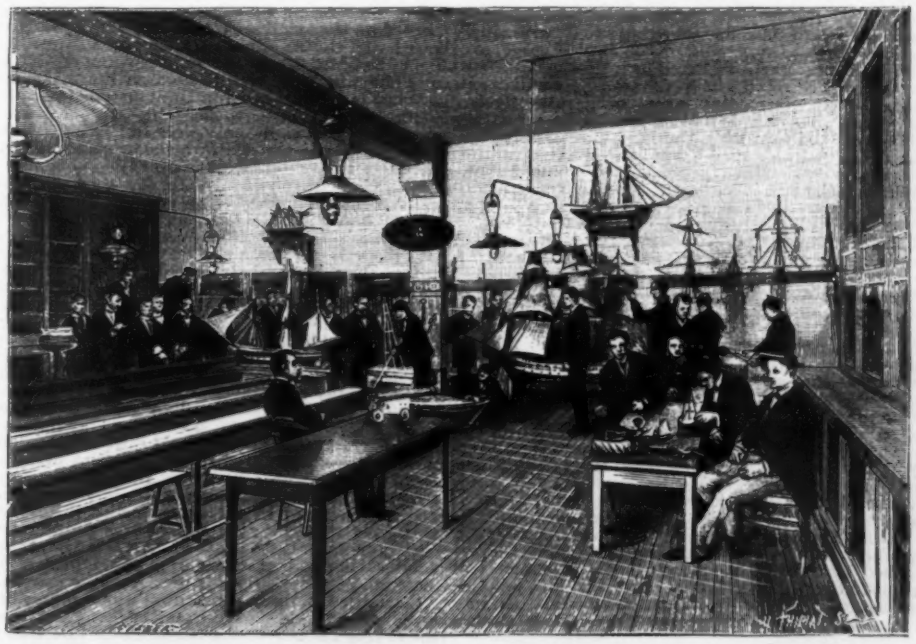


FIG. 3.—INTERIOR OF A STUDY AT THE MARSEILLES SCHOOL FOR CAPTAINS.

comprised among the exempts and perform but one year of service in the capacity of auxiliary midshipmen. One would thus succeed in wiping out the reciprocal prejudices of the officers of the navy and of the mercantile marine, all of whom, in time of danger, must concur in the defense of the country.—*La Nature.*

SOME CAUSES OF MARINE CASUALTIES.

IT is matter for sincere congratulation that the total number of shipping casualties deemed deserving of more searching investigation by the Board of Trade remains almost stationary from year to year, especially when we remember that British merchant ships afloat are being continually added to with unexampled rapidity, and that modern ships make many more passages during their checkered careers than was possible in the old sailing ship age. A careful analysis of such inquiries, held at home ports as recorded in "Our Official Log" during the twelve months of 1891, clearly shows that although many mishaps may occur around our coasts to carrying craft under the British flag, yet few are of sufficiently serious a nature to call for special treatment before properly qualified tribunals. Neglect of the lead in foggy weather when making or leaving the land, a marked tendency in officers of steam cargo carriers to shave outlying dangers in all weathers far too closely, and carelessness in applying one or other of the articles pertaining to the rule of the road, are as usual the principal causes which lead to the suspension of masters' and deck officers' certificates for periods varying with the nature of the case.

Sophocles sang of that peculiar power displayed by the human race in rendering the elements subservient to their will, and his first illustration is happily inspired by the supreme skill and high-souled daring of navigators. Little he imagined, even in his wildest flights of poetic fancy, that the time would come when huge sailing ships, carrying deadweight cargoes of from 3,000 to 6,000 tons over many a league of stormy sea, would be handled by scanty crews averaging about fifteen men per 1,000 tons register! The British flag is on every sea, nevertheless disaster is much more rare than might legitimately be expected. Rudyard Kipling, in his recent ode to the flag that braved a thousand years the battle and the breeze, puts the following well chosen words into the stirring address made by the personified west wind to ingrates at home who yelp at the British flag:

> In squadrons the thoughtless galleons fly,
> That bear the wheat and cattle lest street-bred people die,
> They make my might their porter, they make my house their path,
> And I loose my neck from their service and whelm them all in my wrath.
> But whether in calm or wrack wreath, whether by dark or day,
> I leave them whole to the conger or rip their plates away,
> First of the scattered legions, under a shrieking sky,
> Dipping between the rollers, the English flag goes by.

An army officer, leading a forlorn hope to storm a fort, has the satisfaction of knowing that the eyes of the whole civilized world are upon him, the officer in charge of a warship is somewhat similarly situated; but masters of the merchant service perform deeds of valor every day against the forces of nature arrayed against them. Too often records of the daring deeds are written in sand, but the few misfortunes are carved indelibly in marble. The merchant service does not consist entirely of splendid steamships belonging to first-class companies, as some would have us believe, but includes all sorts and conditions of carrying craft. Steam has induced shipmasters to push boldness into reprehensible recklessness occasionally in hugging headlands, for it must be borne in mind that even the very best of charts is not an infallible guide, and an uncharted rock is a nasty thing to try conclusions with when in such nearness to the land as a prudent navigator would shun.

There is an old adage that it is well to steer for a rock if you wish to keep clear of it, but when too near the land an unknown danger might easily be located by a too confident navigator running his ship thereon in broad daylight. A barquentine, the Minnia, ran ashore on the coast of Brazil because her master kept away for a boat supposed to contain a pilot, despite the fact that his sailing directions distinctly stated that pilots never ventured outside the port. The steamship Derwentwater came to grief because her second officer curiously mistook the light of Cape Finisterre for that of an approaching steamer. His certificate was rightly suspended for twelve months. Downright carelessness has something to do with shipping casualties at times.

The steamship Delta stranded near Heligoland one clear day, and the certificates of master and mate were suspended for twelve and six months respectively. Another steamer, the Marbella, went ashore on the well-lit coast of Spain when the land was plainly visible and the weather fine. Her master left only the most meager verbal instructions upon going below, and did not come on deck again when called on two separate occasions. The mate left in charge of her deck mistook a light shedding forth its warning rays, and simply allowed her to strand without concerning himself further in the matter. Similarly, the mate of the steamship Dee actually noticed her going on shore, but neglected every precaution, and gave no warning whatever to the master. Again, the steamer California went ashore while running along the land near Oruba in charge of her third officer, who was utterly unacquainted with the coast, and failed to appreciate the danger into which his vessel was standing. Her master was on deck, but asleep in a chair, being worn out by previous protracted duty, and it would appear that a quartermaster, sent by the third officer to arouse the master, had been unsuccessful. Obey orders, even if you break owners, is an unwritten law at sea which is more honored in the breach than in the observance. It is an old sailor's expressive manner of stating that, inasmuch as his opinions and experience are despised, he will in future let things take their own course, even when he is well aware that danger threatens. Officers snubbed by their superiors for evincing too much zeal are apt to carry this dangerous principle into practice with disastrous results to all concerned, and this may be the cause of some otherwise unaccountable strandings and collisions.

Better for a young officer to call the master too often at the risk of slight censure than to dally with danger until too late. Neglect of the lead in one ship may indirectly bring misfortune upon another more carefully navigated vessel. For example, the steamship Charles went to the bottom near Harrington in consequence of neglect to heave the lead in hazy weather. Next day the steamer Broughshana came along on the same track, struck this submerged danger and also sank. The steamship Elemore was navigated through a North Sea fishing fleet at full speed and ran down one of the boats. It was proved beyond a doubt that she was without a lookout, no signal to stand by had been given to the engine room, and her chief engineer at this critical time had left the donkeyman in charge. The only wonder is that more fishermen did not suffer by such an unseamanlike method of navigating in narrow waters.

A Newcastle steamship, the Critic, when bound from New York to Leith, collided with a large iceberg, much to the surprise of all on board. Her chief officer had heedlessly left the bridge to assist the men of his watch in their ordinary routine work about the decks, and at the instant of collision her helmsman was the only person suitably placed for observing approaching dangers. Her square foresail was set so that he could not see right ahead, and thus steered directly on to the icy mass which lay in the steamer's track. An able seaman asserted in his evidence that an officer was never known to remain on the bridge of the Critic except in thick weather. This mate had his certificate suspended for six months because he had permitted the bridge to be deserted. It is difficult to understand in what way a young officer, whose living is dependent upon continuity of employment, could evade a master's orders, either expressed or implied, that his officers should leave the bridge and work with the watch in fine weather.

Many steamships are similarly mismanaged, especially under the command of masters who have grown old in sailing ships. Instances are not far to seek where this most dangerous practice has been followed, even on board steamers owned by firms utterly opposed to it. If any one be to blame in a short-handed steamer when an officer leaves the bridge tenantless in order to perform other duties, then let punishment be visited upon the master. He is the person solely responsible and monarch of all he surveys. His subordinates would not dare to vacate the bridge for any purpose whatsoever if they were certain that by so doing the righteous indignation of the master would be visited upon them. Let it be made clear that power has its responsibilities as well as its privileges; but, should an officer leave his post to trim a sail, scrub paint work, or for any cause, against the written orders of his superior, then that offending officer's certificate should be most severely treated. Otherwise let the master be deemed cognizant of such dereliction of duty and dealt with accordingly; for implicit obedience is a virtue at sea, and an officer should not be punished for leaving the bridge under circumstances over which he can have no control and frequently against his better judgment.

A fine sailing ship, the Balmoral, was cast away near Johnshaven while homeward bound from Calcutta with a valuable cargo of jute for Dundee. Her master had been promoted to this ship in consequence of sterling seamanship displayed in navigating the bark Lyra round Cape Horn to Queenstown, under jury masts. She had been dismasted one month after leaving Pisagua, when about 350 miles off Valparaiso, but was brought home without putting into any port on the way. The mate of the Balmoral was a sleeping partner in her navigation; the master made a simple slip in the arithmetical part of his calculations which vitiated his position to the extent of five miles. His working was unchecked, and so the Balmoral went ashore in foggy weather.

This one man navigation has many objections, and but little if anything can be urged in favor of its adoption or retention. That man alone is free from making mistakes who never does any work; and even a shipmaster, after the microscopically minute but utterly undesirable arithmetical accuracy of a Board of Trade examination, will not infrequently be put to shame if he rely entirely on his own calculations. The London Shipmasters' Society officials are altogether opposed to such an affectation of infallibility by a shipmaster of the mercantile marine. The steamship General Elliot was badly dealt with by that well known current off Cape Finisterre; and the Batley was likewise troubled by the indraft into the Bay of Biscay. Another steamer, the Trent, struck on a rock not marked on the small scale chart by which she was navigated; and the St. Donat stranded on a shoal in the Black Sea which was shown in position on the Admiralty chart for that part, but not on the one used by her master. The steamship Dunmurry capsized in the North Atlantic owing to her bulk cargo of grain having shifted, and eight lives were lost. Shipmasters of to-day should be familiar with the principle underlying the use of ballast tanks and stability in general. At a critical moment the wheel chain of a steamship parted, and a collision ensued with another, that foundered with all hands. The Whitehall, which would probably have been in about that position when the collision took place, is missing, and a trawler has brought to the surface some wreckage supposed to have belonged to her. In another case, that of the steamer Carrier, a link in the steam steering gear broke, and the hand gear became jammed while connecting it. The sailing ship Ellen A. Reed, of 1,750 tons register, met with a sad accident when in 50° S. 47° W., homeward bound from Tacoma to Bristol with a cargo of grain. A link in her outer bobstay parted, causing the jibboom to snap short off and the three topgallant masts to go over the side. A man was on each skysail yard at that instant stowing the skysails, which had just been taken in, and all three men were drowned, despite every effort made to save them. No fewer than four steamships were adjudged to be undermanned, but there was not a single instance of an unseaworthy ship, and it is gratifying to find that in no case was drunkenness of master or officer the cause of disaster. This fact speaks volumes in favor of the hard-worked officers of the many and various ships of our mercantile marine.

Casualties to ships, concerning which inquiries have been held at home ports during the period embraced by the twelve numbers of this magazine for 1891, may fairly be classed under the following heads: Neglect of the lead, negligent navigation, stress of weather, collision, erroneous inferences with respect to lights, soundings, tides, and currents; explosion, foundering, fire, and unknown dangers. Forty-one vessels were incautiously navigated, 21 came to grief by neglect of the lead, 18 suffered through stress of weather, there were 14 cases of collision affecting 28 ships, 9 were endangered by erroneous inferences with respect to lights and currents, 4 struck unknown submerged dangers, 1 was burnt, 1 was damaged by an explosion caused by coal gas coming into contact with a naked light, and 1 ship has not been heard of since leaving England. Not one of these ships was proved to have been faulty in construction or overladen. Thirty-one of them were coal laden, 25 were in ballast, 19 had general cargoes, 15 carried timber, 12 grain, 10 various metals and ores, 4 nitrate, 4 cotton, 2 manure, 1 salt, 1 oil, 1 herrings, 1 fruit, 1 cement, and 1 sugar. The ages of the vessels concerned were as follows:

Years old...	0-9	10-19	20-29	30-39	40-49	Not stated.
Number of ships.	58	37	16	5	2	10

Some of the masters were merely cautioned, others were censured, and one had his certificate suspended for 18 months; but six months of disgrace seems the usual decision. Masters must never forget that it is wiser to err on the side of caution; for saving a tide, or prompt delivery of mails, cannot be weighed in a balance against human life, and excessive eagerness to make a passage may mean professional ruin.

Similar inquiries held at ports abroad slightly exceed in number those of home ports, and are of a somewhat more serious nature, as may be gleaned from the pertinent fact that no fewer than four masters had their certificates canceled. In one case, the schooner Perseverance was prematurely abandoned, for, although her foremast had gone, she might easily have been towed into port if her master had accepted the services of a passing steamer, which were offered but refused. In a second case, the master of the bark Earn kept no record of her position, navigated by old, unreliable charts, and abandoned his vessel without just cause. A third master navigated the bark Raven on similar want of principle, with like results to ship and shipmaster. Last, but not least, was the splendid sailing ship Craigburn, lost near Port Phillip Heads, in consequence of acts of omission and commission on the part of her master and mate. The former had his certificate canceled, the latter paid the penalty of drunkenness with his life. Her master was also compelled to pay £25 toward defraying the court expenses, and, unfortunately, four other lives were sacrificed. Men seldom become thorough-paced drunkards in an instant, and it seems probable that a rigid scrutiny by shipowners or their representatives would effectually weed out the few objectionable characters that still offer their services to command or officer a valuable ship at an inferior rate of pay to the detriment of reliable men. The bark Ellen affords another startling example of terrible suffering, loss of life, destruction of property, caused by the drunkenness of responsible officers. She was bound from Newcastle, N. S. W., to Noumea, when a gale arose at a time when her master was below, laid up by an accident, and her first mate drunk and incapable. She was laid to under improper canvas at the commencement of the breeze, and eventually abandoned by her crew of ten men, who were huddled up in a small boat, without water and in possession of only a scanty amount of food. The captain became insane and died; the steward followed within a few hours. Soon after a heavy sea swept two men out of the boat, and three seamen went mad through drinking salt water, and jumped overboard to a watery grave. The few stricken survivors had been nine days without a drop of fresh water and two days without a morsel to eat when the land was made. Only one man escaped from the savage surf to tell the tale. An iron bark, of 800 tons register, the Compadre, bound from Calcutta to Chile, was burnt through the spontaneous combustion of her jute cargo; every aperture leading to her hold was closed, and she was kept away for New Zealand, but a storm drove her on to the Auckland Islands. The doomed ship was well alight, so that her crew lost all their belongings. A small store of provisions is left upon these uninhabited islands by the British government for the sustenance of any castaways that may reach them, so that the crew of the Compadre providentially discovered a few tins of biscuits and a dozen small tins of preserved meat. They eked out this scanty stock by the aid of sea birds, seals, and similar makeshifts, on which they existed 100 days, dwelling in an old hut. At the expiration of this succession of leaden footed hours the schooner Janet Ramsay hove in sight, observed the signals flying on shore, rescued the crew, and carried them to New Zealand. A brigantine, the Eastward, lost all her fresh water during a gale of wind; her master landed on the coast of Brazil to obtain some more, but being unable to return to his vessel she was beached by the mate in order to save the lives of her crew, and the court of inquiry held him blameless. The steamer Rothesay tried to enter Galle without a pilot, notwithstanding the prohibitory advice of sailing directions, and she struck on Matamada Rock. Cross bearings had been taken but not used, and her master's certificate was suspended for twelve months. A sailing ship, the Joseph H. Scammell, went ashore near Port Phillip, owing to the neglect of the lead and omission to signal for a pilot after daylight. Her master was fined 100 guineas, and lost his certificate for twelve months. A collision took place in Madura Strait between two steamships, the Devonhurst and the Strathendrick, and the latter sank. Both vessels were deemed blameworthy, inasmuch as the mate of the Devonhurst broke Art. 16 and the second mate of the Strathendrick failed to comply with the provisions of Art. 18. The former officer had his certificate taken away for two years and the latter for three months. In a collision between the steamship Fairfield and H. M. S. Hecla, the latter was held in fault. Our readers will remember the collision between the steamship Utopia and H. M. S. Anson, in Gibraltar Bay, when, owing to an unfortunate error of judgment on the part of the mercantile marine commander, 600 lives were lost. The Utopia, threading her way through a crowded anchorage in inclement weather, drifted across the death-dealing ram of the Anson, and sank almost instantaneously. A tank steamer, the Pollux, was left to her fate in the North Atlantic with rudder carried away, leaking badly, and her fires put

out by the rising water. She had been sighted by the Michigan, in a sad condition, on 28th November, 1890, but her master would not be prevailed upon to desert his ship, which drifted about in a helpless condition until 20th December, when her crew was rescued by the State of Nevada, in 54° N. 21° W. An error of five miles in position laid down on working chart, due to a simple slip in calculation, was partly the cause of the stranding of the steamship Coventina; but there was also careless navigation, bringing censure to both master and mate. The steamship Transition struck some floating substance and received damage. Two sailing ships, the Andora and the Sir R. Fernie, and a steamship, the Clan Drummond, were in collision at one time in the River Hooghly, owing to an error of judgment. A large sailer, the Bruce, capsized by accident while shifting to her loading berth in New York harbor. The ship Indore and the bark Callirhoe collided in the Hooghly in consequence of the carrying away of the bark's wheel rope. A steamship, the Clan Mackay, met with misfortune owing to her steering gear jamming. The brigantine Meg Merrilies was in trouble at the New Hebrides and also at the Solomon Group. Her master was fined eight guineas to defray costs, and his certificate suspended for six months. Three sailing ships, the Riversdale, the Loch Naw, and the Ayrshire, went on the reefs of New Caledonia. Their charts and sailing directions were not sufficiently accurate to insure safety, and uncharted reefs exist in that locality. A well found sailing ship, the Marlborough, left a New Zealand port for London, laden with frozen meat; she was spoken when two days out, but not a vestige of her has since been seen. Two other similarly laden sailing ships subsequently disappeared while homeward bound along the same route. Of 127 shipping casualties inquired into at ports abroad, 24 were due to collisions, in which 49 ships were concerned, 27 to reckless navigation, 24 to stress of weather, 11 to erroneous inferences, 10 to neglect of the lead, 5 to fire, 5 to the use of unreliable charts, 17 to accident; 3 vessels have not been heard of since leaving the land many months ago, and 1 was unseaworthy. The last mentioned vessel was a small coaster of the West Indies, so that, practically, not one sea-going carrying craft proved incapable of keeping the sea out of the 237 inquiries, numbered from 4,171 to 4,407, both numbers inclusive; and navigation is far from being as risky as some people assert. "We trust our lives to seamen," said Thackeray, "and how nobly they fulfill their trust."—*Nautical Magazine.*

APPARATUS FOR REGISTERING THE PRACTICAL WORK OF AGRICULTURAL MACHINES.

BEFORE giving a description of Mr. Ringelmann's kinematic registering apparatus, represented in Fig. 1, we shall have a few words to say about his dynamometric carriage (Fig. 2).

The old carriages were mounted upon four wheels, an arrangement essentially bad, since it is not always possible to make a plane pass by four points. The apparatus was unstable, and as the spring plates were bolted to the carriage, they followed its lateral displacements and were apt to give inaccurate indications.

Mr. Ringelmann's carriage has three wheels, and this gives it a better balance, whatever be the nature of the ground. Moreover, the front wheel is movable in a horizontal plane, in order that it may more easily follow the variations of traction. The dynamometer, rendered completely independent of the carriage, is jointed to a horizontal axis and so balanced as to assume the inclination of the traction automatically. It is regulated in the vertical plane according to the height of the machines to be tested. So, too, the trace hook, placed over the forewheel, can be regulated in the vertical plane in such a way that it may be put at the level of the draw gear. Finally, in order to prevent any tendency to upsetting when the carriage is running over a declivity, the left hind wheel may be moved vertically by acting upon a hand wheel placed within reach of the operator.

Two shaft straps fixed upon the hind crossbar of the carriage receive the shafts when the machine to be tested is provided therewith. The shafts then rest upon two rollers, so that the traction may be effected entirely upon the dynamometer, an essential condition for the obtaining of accurate indications of the work absorbed.

For tests with the registering apparatus, the carriage is so arranged as to receive the batteries and accessories.

Upon the whole, it will be seen that, in this arrangement, the carriage is stationary, the dynamometer alone varying so as always to take the inclination of the traction. In the old apparatus, on the contrary, the dynamometer was fixed to the carriage, and it was the latter that had to incline in the direction of the traction.

Let us now see what role is played by the kinematic registering apparatus shown in Fig. 1.

Let us suppose (as is the case in our figure) that the machine to be tested is a plow. In order to estimate the practical work effected by this machine for an expenditure of motive power indicated by the dynamometer, it was necessary to measure the depth and width of the furrow from point to point by means of a meter. As these dimensions are apt to vary within quite wide limits, it will be seen that this method, which was very lengthy, could scarcely give any other than quite uncertain results, which in all cases were insufficient to permit of following at every instant the comparative variations of the power and resistance—indications that are very valuable in a large number of cases.

It is precisely the object of the kinematic registering apparatus to fill this gap by continually and automatically measuring these quantities upon the same band of paper, which unrolls at the dynamometer.

It consists of a manipulator fixed upon the machine to be tested and of a receiver so arranged that it can be mounted upon the dynamometer.

The manipulator (1, Fig. 1) consists of an exploring wheel, R, which rolls upon the ground at a short distance from the plane of the stanchions. This wheel, therefore, displaces itself vertically with respect to the plane of the socket rod, which is taken as a plane of

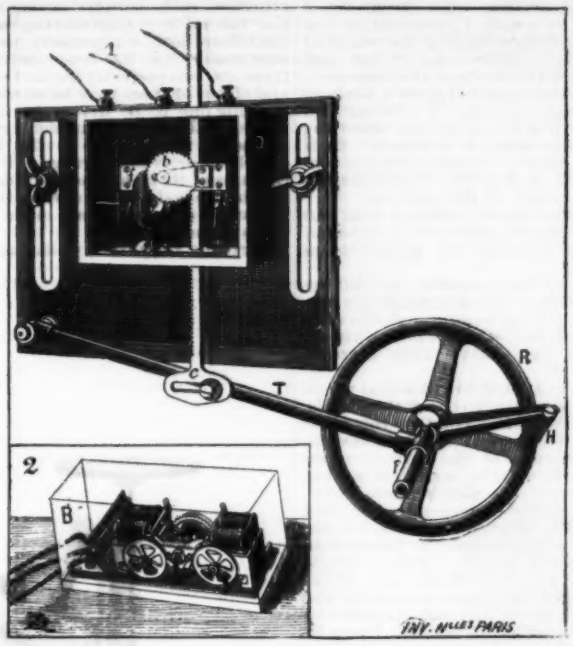


FIG. 1.—KINEMATIC REGISTERING APPARATUS.
1. Details of the manipulator. 2. Details of the receiver.

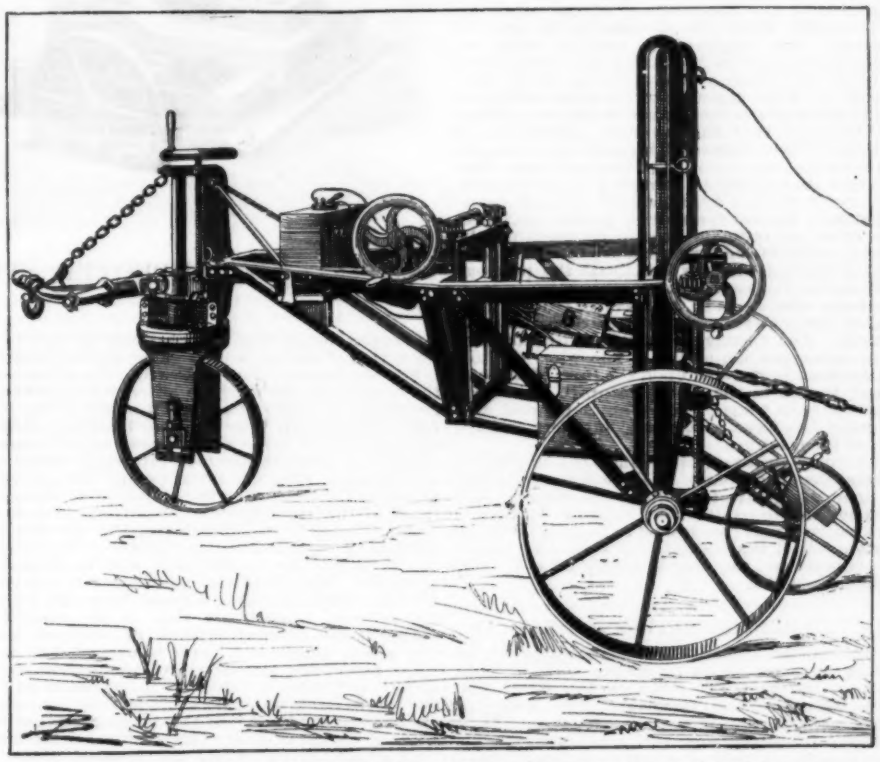


FIG. 2.—DYNAMOMETRIC CARRIAGE PROVIDED WITH A RECEIVER, B.

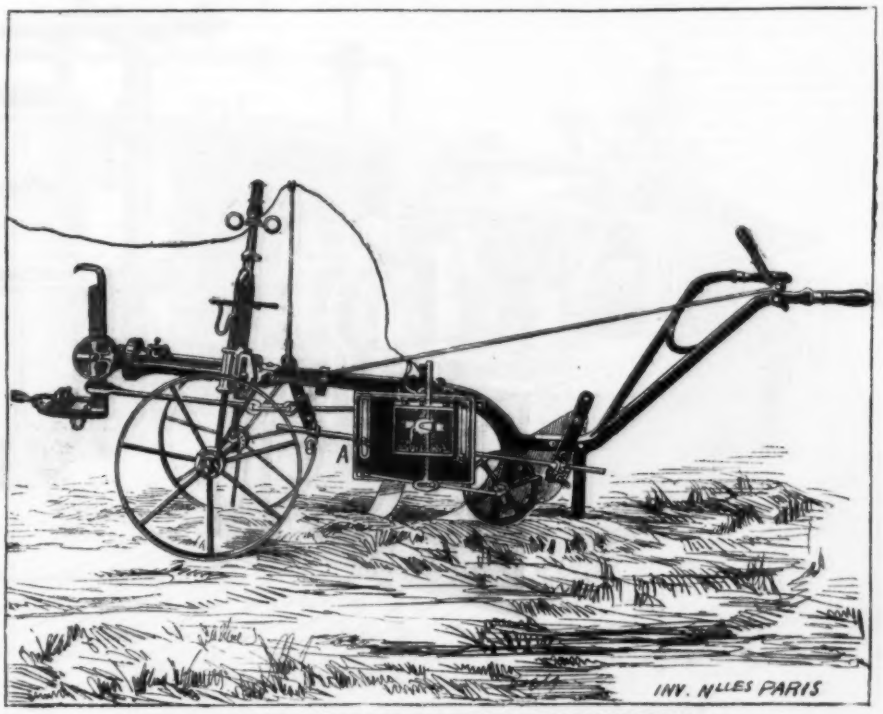


FIG. 3.—PLOW PROVIDED WITH A MANIPULATOR, A.

comparison. The displacements are transmitted through a hollow rod, T, to a rack, C, terminating in a guide in which slides the button fixed at the center of the rod, so that the vertical displacement of the rack corresponds exactly to half the depth of the furrow.

The rack actuates a pinion mounted upon a horizontal axis, capable, through rachets, of driving two toothed wheels, *b*, one of which is actuated when the rack ascends, and the other when it descends. Each ratchet wheel controls a detent, *t t'*, that carries a contact. Each displacement of a tooth establishes the contact, and the current is sent to the receiver.

The apparatus is mounted upon a plate, A, that can be fixed by two strong thumb screws to a tube fastened to the machine to be tested by special straps (Fig. 3).

The current furnished by the batteries installed upon the dynamometric carriage arrives through the central wire 1 and returns to the battery through the wires placed to the right and left of the first. These wires are twisted together in order to facilitate their carriage and putting in place.

The receiver (2, Fig. 1) consists of two identical mechanisms, one of them corresponding to one of the wheels, *b*, of the manipulator, and the second to the other wheel. Each of these systems consists of an electromagnet, which at each passage of the current causes a ratchet wheel to move forward by one tooth, so that to every movement of one of the wheels there corresponds an identical one of the corresponding ratchet wheel of the receiver. The algebraic sum of the displacements of these two wheels is made by means of an epicycloidal train, composed of a bevel pinion revolving between two bevel wheels. When one of the ratchet wheels is actuated, the other remaining stationary, the bevel pinion moves in a vertical plane by a certain angle, and in a certain direction. Upon its instantaneous axis of rotation, which is prolonged beyond the frame, is keyed a wheel which controls a rack that carries the registering pencil. The latter inscribes upon the paper of the dynamometer an ordinate which is a function of the displacement of the exploring wheel, to a scale known in advance by the ratio of the gearings. The height of this ordinate varies, according as the rack moves in one direction or the other, that is to say, according as the exploring wheel rises or descends, or, what amounts to the same thing, according as the depth of the furrow increases or diminishes. The paper that receives these indications, as well as those of the dynamometric pencil, moves in proportion with the rate of motion of the machine. The result is that the indications furnished by the two pencils are, one of them, a dynamometric ordinate representing at each instant the motive power developed, and the other an ordinate exactly representing the lengthwise profile of the furrow made by the plow, and the measurement of which will indicate the practical work effected at the same instant.

As we have already said, the receiver is fixed upon the dynamometer and consequently participates in all its motions. The carriage is provided with three dry batteries, connected in quantity. The wires run to a central commutator, placed upon the front of the carriage, and thence to the manipulator, B, fixed upon the machine to be tested. They are supported at a certain height by forks, so as not to interfere with the motions of the machine.

What we have just said will suffice to allow one to understand the operations of this ingenious apparatus, which does the greatest credit to its inventor and which is destined to render most valuable services in all cases where it may be desired to have an absolute comparison of all the instants between any motive power whatever and the practical work effected.—*Les Inventions Nouvelles.*

IMPROVED REFRIGERATING MACHINERY.

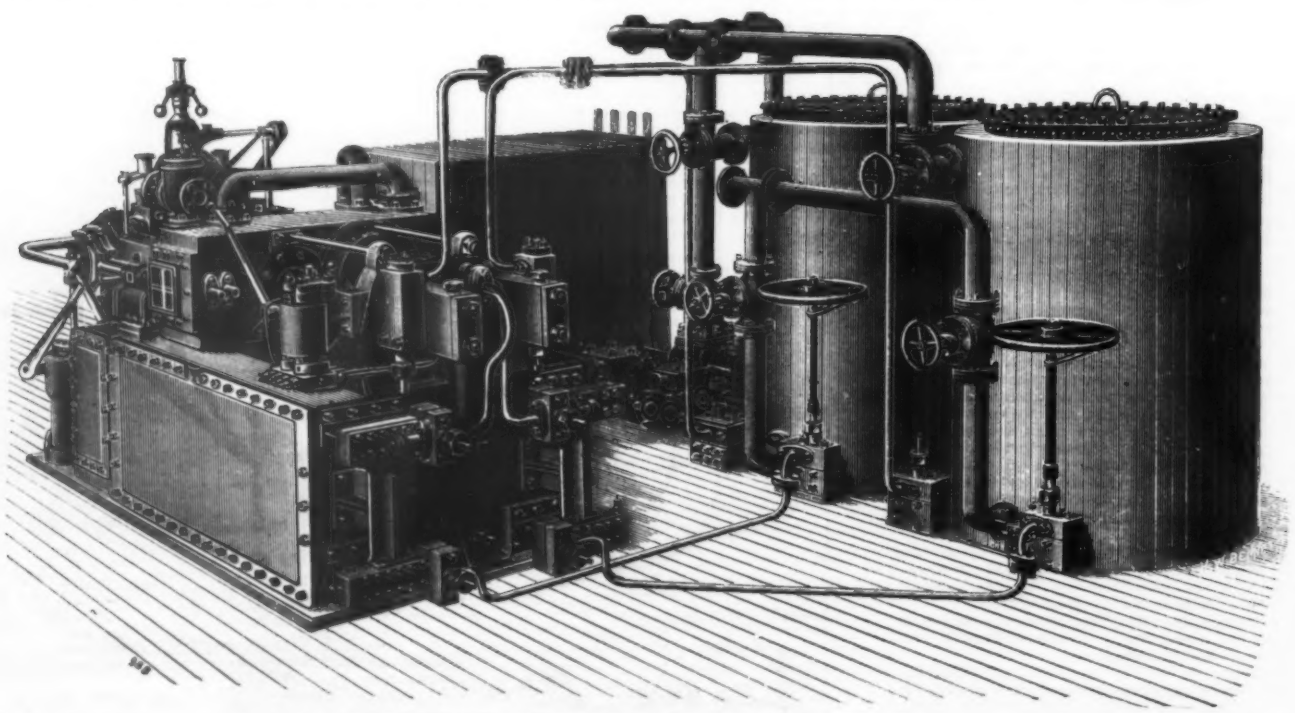
Our illustration shows the carbonic anhydride refrigerating machine made by Messrs. J. & E. Hall, Limited, of Dartford, and fitted on the White Star steamers Britannic and Germanic for preserving a cargo of 2,600 quarters of beef in each ship. These large ships ply between New York and Liverpool. The machine is of the duplex type, with compound steam cylinders, each cylinder having a compressor placed in line behind it. *Engineering* says: Under ordinary conditions both compressors are worked, but as each compressor has its own condenser and refrigerator, there are two perfectly distinct refrigerating machines, and either of them may be uncoupled, leaving the remaining one to be driven by the compound engine. Either of them is of sufficient power to maintain the necessary temperature in the holds, thus affording double security to the cargo. The bed of the machine contains at its front end the steam surface condenser, and in the body of the casting the carbonic anhydride condenser coils, which are made of solid-drawn copper pipes without joints in the bed.

Carbonic anhydride, unlike ammonia, has no affinity for copper, hence that material can be used to resist the action of the sea water. The carbonic anhydride is first compressed, then passes into the condensers in the bedplate of the machine where it is liquefied, and thence in the form of a liquid it passes to the refrigerator and expands here into coiled pipes, and absorbs the heat of the brine which passes round these coils, and thence to the meat holds, returning finally to the refrigerator. Separate brine pumps in duplicate are provided for circulating the cooled brine through the pipes in the meat holds. The machine illustrated, when running at its normal speed of 100 revolutions per minute, indicates 23 horse power. The pump piston is packed by cup leathers, and lubricated with glycerine. The gland also consists of two cup leathers between which glycerine is forced in under a pressure 10 per cent. greater than that in the pump barrel. Owing to this a certain amount of glycerine leaks in the pump barrel, and has to be extracted by a separator before the gas passes to the condenser. The suction and delivery valves are made out of tool steel, the valves being coned at 45°, while the seats, also of steel, are rounded, so that the bearing surface is very narrow. Relief or safety valves are also fitted to prevent a break-down in case the pressure in the pump barrel becomes excessive. Essentially, these valves consist of a disk of copper, which will give way under a pressure of 1,500 lb. Above this disk is a spring-loaded relief valve which is opened by the pressure, after the copper disk has been burst through. A certain amount of the liquefied gas is drawn over from the refrigerator by the pump, in addition to the gaseous CO_2. This liquid is converted into gas during the compression stroke by the heat then developed, and owing to its latent heat keeps down the temperature in the pump. The joints between the various parts of the refrigerator are made by jointless copper rings, compressed between two faced surfaces, and in spite of the high pressures employed—about 50 atmospheres—are said to be absolutely tight. The machine is very compact and occupies much less space than cold air or ammonia machines of equal power. The various parts being small can easily be made of ample strength.

IMPROVED STEAM CROSS-CUT SAW.

STEAM CROSS-CUT SAW.

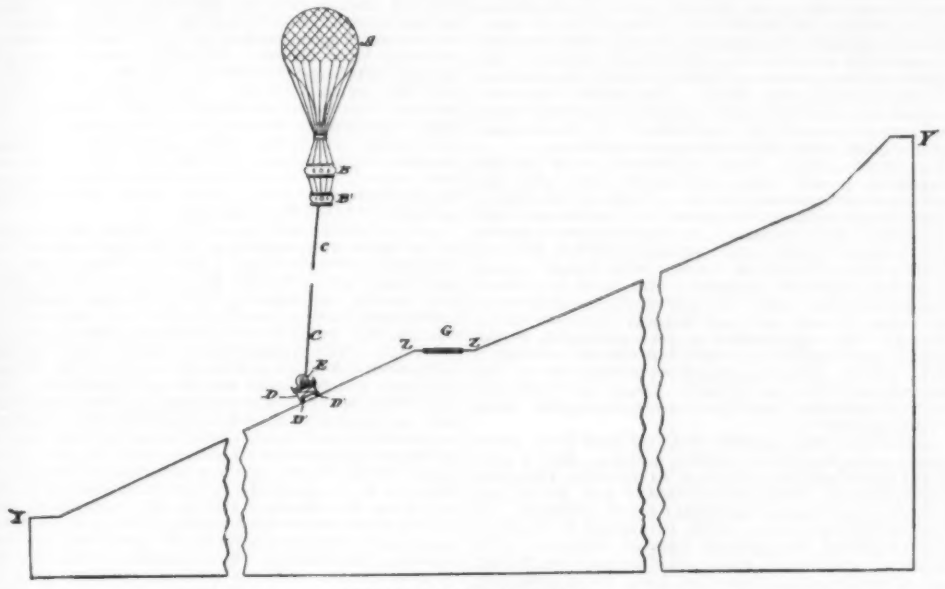
This is a new machine brought out by A. Ransome & Co., of Chelsea. The machine is fixed upon a short bed or gantry along which it can be readily moved lengthwise of the log by turning the hand wheel shown attached to the face of the machine. By this arrangement the saw can readily be adjusted exactly opposite to the spot at which it is desired to cross-cut the log, thus saving considerable time and labor in adjusting the log in the exact required position in front of the saw. The quadrant which controls the vertical range of the saw is made of sufficient length to allow of the cylinder with its saw and attachments being brought into a vertical position, thus leaving the entrance to the mill quite clear for the passage of the timber. The machine is capable of cross-cutting trees as large as 6 feet in diameter, and even in smaller timber the great rapidity with which it works is said to make it more economical than any other description of cross-cut saw.—*Iron.*



IMPROVED REFRIGERATING MACHINERY.

A BALLOON RAILWAY.

THIS is by Lucien Payn, of Paris. An ordinary balloon, A, is connected to one or several balloon cars, B B', which may or may not communicate one with the other by means of ladders or otherwise, the whole balloon, with its car or cars, being attached by means of a cable, C, of variable length to a box car, D, on which a winch, E, is mounted, which serves to wind up the cable. The car, D, rolls on the road and is formed of rails which form vertical grooves, in which the rollers, D', are imprisoned. The car, D, has also the horizontal rollers, D'', which, resting against the vertical sides, d'', of the rails, D', maintain the vertical position of the car in case of sudden gusts of wind. The whole of this system rolls on a suitable road, which can be sloping, as shown. Two roads are preferably made, in a north south, east, and west direction, which cross at right angles at their midst, G—for instance, where a horizontal platform is arranged with a turning plate—permitting, when necessary, of changing at will the direction of the balloon.



A BALLOON RAILWAY.

Supposing one wanted to go upward in the direction of X Y, which demands naturally that the wind blows in that direction, the cable, C, is rolled off the winch, E, and the balloon rising follows the impulse of the wind and draws with it the car, D. Upon the arrival at Z on the platform the same direction, Y, is kept in, or if, in consequence of a change in the direction of the wind, it is deemed necessary to also change the direction of the balloon, the car is turned on the turning plate arranged on this platform, so as to take an inclined direction of ninety per cent. in regard to the first direction, X Y. When at Y or Y', the position corresponding at ninety per cent. to the position, Y, on the road, the balloon is drawn down by means of the winch, E, so as to diminish as much as possible the action of the wind, the box on the car, D, is filled with water through opening, E', or the platform loaded with persons, thus forming ballast, and the descent of the road, Y X, is made without the aid of the balloon to the spot, X, the starting point, changing the direction again or not when arriving on the platform, Z.

THE INTENSITY OF THE RADIATION OF GAS UNDER THE INFLUENCE OF ELECTRICAL DISCHARGE.

THE interesting phenomena which accompany electrical discharges through rarefied gases, although still for the most part unexplained, have of late been repeatedly investigated both in the optical and in the electrical direction. The quantitative relation between the optical and the electrical phenomena has, however, been but little studied. Now, it is only by a more perfect knowledge of this relationship that we may hope to understand and explain the origin and the nature of the radiation which is observed in Geissler's tubes, as also the part which electricity plays in those remarkable phenomena.

Researches have been made by E. Wiedemann, and more recently by Staub in this direction; but, however valuable their results may have been, they do not give a direct answer to the question of the radiation of the gas under the action of the electric discharge. Hence we are glad to notice that K. Angstrom has approached the subject, and has been using the bolometer in the endeavor to determine the radiation of different gases under the action of the electrical current; to express the intensity of this radiation in absolute measure, and to endeavor, then, to determine the relation of the radiation to the causes which produce it.

After a year's work, the preliminary trial experiments are completed, and some rather important results have been obtained which form the substance of a communication to the April number of the *Philosophical Magazine*, where our readers may find details of the way the experiments were conducted.

The researches extended to oxygen and hydrogen liberated by electrolysis of pure water acidulated by phosphoric acid, to nitrogen produced by leading pure air freed from carbonic acid over heated copper, and to carbonic acid produced by heating sulphuric acid mixed with oxalic acid, and purified by passing through a solution of potash.

The most important results of this investigation may be summarized as follows:

For a given pressure, the radiation of positive light is proportional to the intensity of the principal current. It is true that on using very powerful currents small divergences are observed, but in this case they are always accompanied by a permanent alteration of the gas, so that the same radiation is not met with again for less strong currents.

If the electric current is kept constant, and the pressure is varied, it appears that the intensity of total radiation scarcely varies between the limits of 0·1 to 1·5 mm., but it increases a little at higher pressures. At pressures exceeding 1·5 mm. the character of the discharge seems to be modified, after which the radiation increases considerably with the pressure after having passed, at any rate in certain cases, through a minimum.

For the same gas under the same pressures the composition of the radiation is constant, and does not depend on the intensity of the electrical current.

When the density of the gas changes, the composition of the radiation changes also, in so far that the ratio of the intensity of radiation of the shorter wave lengths to that of the total radiation decreases with increase of pressure. This ratio varies, *e. g.*, between the pressures 0·1—1·6 mm., for carbonic acid from 46 to 15 per cent., and for nitrogen from 94 to 60 per cent.

The ratio between the luminous and total radiation rises to considerable values for very low pressures, values far greater than those of our ordinary luminous sources. It does not, however, always attain such high value in the electrical discharge in rarefied gases. At pressures of 5—10 mm. it is rather small.

The intensity of the total radiation varies greatly for different gases. It is not in a simple ratio with the molecular weight of the substance, or with the difference of potential in the layer of radiating gas. It does not appear to depend essentially on the absorption of the gas at the ordinary pressures and temperatures, either as regards its intensity or in reference to its composition.

In the case of low pressures the following explanation is given by Angstrom: When the rarefied gas becomes a conductor of an electrical current, it is the molecules principally which serve to transport electricity, that is to say, the active molecules which radiate.

The number of these molecules is proportional to the intensity of the current, and varies but little with the variations of pressures as long as the discharge retains its character. This radiation is of an irregular character, according to Von Helmholtz, or it belongs to the class of phenomena termed by E. Wiedemann *phenomena of luminescence*, in this sense, that the composition of the radiation does not correspond with the temperature of the gas. The radiation may be of extreme intensity in the groups of short wave lengths.

When the pressure increases, and with it the number of inactive molecules, the irregular radiation of the active molecules may more easily be transmitted to the former. The number of radiating molecules increases therefore, and consequently also the radiation of the gas, but it changes in character in this sense, that the radiation of the groups of shorter wave lengths diminishes.—*The Electrical Review.*

IMPROVED STORAGE BATTERY.

THE Ford-Washburn Storelectro Company, of Cleveland, O., through Electrician Washburn has been experimenting for some months on a new storage cell, and the work has just been brought to a point where the details of the cell may be explained to the public.

The accompanying cuts, Fig. 1, and cross section, Fig. 2, will give a clear idea of the construction of the battery. Strictly speaking no plates are used, the cell consisting of six elements, each made up in the form of an oblong cup, Fig. 2. The negative element proper consists of a perforated lead sheet inside of which, and next to a porous cell, is the active material. Inside of the porous cup there is a copper plate extending to the bottom of the cell and on the outside of this plate and next to the porous cup is the active material. The copper plate and its active material forms the positive plate.

It will be seen that in this cell the active material is held rigidly in place, and it is claimed that repeated charging will have no effect to loosen the active material from the lead or copper.

A representative of the *Western Electrician* was in Cleveland last week and through the courtesy of Mr. Ford was invited to a ride in a street car equipped with this battery. With other guests on board, the car was run over Jennings Avenue to South Cleveland, the round trip covering fully six miles. The car was propelled at a high rate of speed, and the exhibition was a decided success.

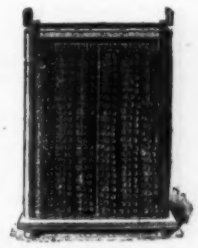


FIG. 1.—FORD-WASHBURN STORAGE BATTERY.

THE PHOTOGRAPHING OF COLORS.

By M. G. LIPPMAN.

1. IN the first communication upon this subject, which I had the honor of presenting to the Academy, I stated that the sensitive coatings I had employed were then lacking in respect of sensibility and of isochromatism, and that those defects formed the principal obstacle to the general application of the method which I had devised. I have since that time succeeded in improving the sensitive film, and, although there remains still much to be done, the later results prove sufficiently encouraging to allow of my imparting them to the Academy.

2. Upon coatings of albumino-bromide of silver, rendered orthochromatic by means of azaline and cyanine, I obtain highly brilliant photographs of the spectrum. All the colors come out at once, even the red, without the interposition of colored screens, and upon one exposure comprised within the space of from five to thirty seconds. Upon two of the plates it was observed that the colors visible by transmitted light are very precisely the complementaries of those which one perceives by reflection.

3. The theory indicates that the compound colors which characterize natural objects should come out in photography, upon the same principle as the simple hues of the spectrum. It is, however, none the less necessary to verify the fact experimentally. The four plates which I have the honor to submit to the Academy represent faithfully objects sufficiently diverse. A church window in four colors—red, green, blue, yellow; a group of banners; a plate of oranges surmounted with a red poppy; a parrot of many-colored plumage. They show that the relief is rendered at the same time with the colors. The flags and the bird necessitated from five to ten minutes' exposure to the electric light or to sunlight. The other objects were secured after several hours' exposure to diffused light. The green of leaves, the gray of stone from a building, are upon another plate perfectly brought out; the blue of the sky, on the contrary, became indigo. It remains, accordingly, to perfect the orthochromatism of the prepared plate and to augment considerably its sensitiveness.—*Comptes Rendus*, April 25, 1892.

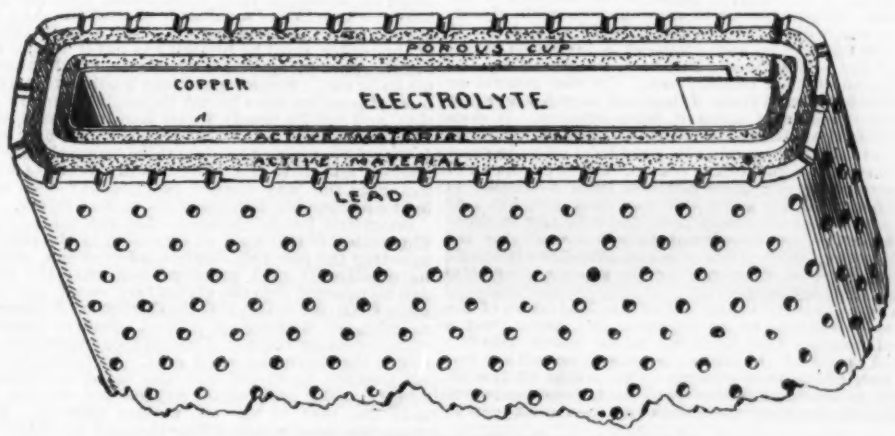


FIG. 2.—FORD-WASHBURN STORAGE BATTERY.

[Continued from SUPPLEMENT, No. 861, page 13766.]

ON PEROXIDE OF HYDROGEN: A PHYSICAL-MEDICAL RESEARCH.*

By BENJAMIN WARD RICHARDSON, M.D., F.R.S.

PART III.—FURTHER PRACTICAL RESEARCH ON THE APPLICATION OF THE PEROXIDE AS A REMEDY.

Uses of the Peroxide in Disease.

In Epilepsy.—In *Asclepiad*, Volume II., page 346, I have related the results of some trials of the peroxide of hydrogen in the treatment of epilepsy. The reader is referred to this short essay, but I may state here in abstract that the facts relating to five cases of typical character are there related. In all of them the peroxide seemed to render useful service; and the last case mentioned in that paper deserves a special note here, because the patient still survives, far advanced in age. This patient, the wife of a professional man, was subject thirty years ago to frequent seizures of severe epileptic character. I prescribed for her two fluid drachm doses of the solution of ten volume strength twice daily in water, and from the first administration she and her friend were sincere in the belief that the attacks were reduced both in frequency and severity. For seven years she held the remedy always at hand, convinced that whenever she ceased to use it the attacks always returned. She continued to resort to it for some time afterward, and finally made a perfect recovery. Of late years she has suffered from partial paralysis of the lower limbs, which has confined her greatly to the house, but now, bordering on eighty years, she is in fair health, eats and sleeps well, and enjoys a moderate share of mental activity. I should add that more than once during the course of treatment under the peroxide this patient had a slight ptyalism, which did no mischief at the time, but which she thought relieved her of symptoms of oppression and weight in the head attended with vertigo.

A systematic investigation of the value of the peroxide in epilepsy, and especially in what is called "Jacksonian epilepsy," is worth the labor. The dose of the ten volume solution may begin at one fluid drachm, and be increased to two drachms, twice daily, in water sweetened with glycerine.

In Anemia.—In 1862 I had prescribed the peroxide in forty-four cases of anemia, and I have repeatedly prescribed it since for anemia. Of itself it has not, I think, any specific virtue in anemia, but from the first it seemed to me to increase the value of iron as a remedy. I have usually ordered it in combination with small doses of sulphate of iron, one grain of the sulphate with one to two fluid drachms of the ten volume solution in two ounces of water, three times a day. In one example of pernicious anemia I carried the dose of the solution up to four fluid drachms, with the small dose of iron three times a day, and with very good results. I speak guardedly on the value of the solution in anemia, because before and since, in treating the disease, I have seen so much good arise from free purgation, I have failed in no instance to add that method of treatment as a necessary eliminative measure. The peroxide is on the same lines, and seems to me to promote both bilial and pancreative secretion, on which, perhaps, its value largely depends. But it gives also effect to the iron, and increases the action of the small dose, possibly by causing absorption of it from the alimentary canal into the circulation.

In Mesenteric Disease and Struma.—The solution promised to be useful in mesenteric disease, and from the first I have prescribed it in this malady. It is not a remedy very acceptable to children, for it leaves in the mouth and throat a metallic taste, which is objectionable. I have endeavored to get over the objection by giving it in combination with glycerine—one fluid drachm with the same quantity of glycerine in six drachms of water and with twenty minims of rectified spirit. An agreeable mixture is produced by this formula, and I have much reason to be satisfied with the effect. The service most appreciable from it is the improvement in digestion which almost invariably takes place, and which renders the administration of cod liver oil and iron more acceptable and useful. This observation extends to its employment in strumous affections generally, and in two cases of large strumous glands in the neck I had a suspicion that the enlargement was reduced under the influence of the medicine by a direct effect. It is not unreasonable to assume that a medicine which excites free action of secreting glands, like the salivary, might exert an action on an enlarged and strumous gland; but I do not press this view, since the obvious improvement in the general health may have accounted for the local improvement, which was unmistakable.

In Diphtheria.—Owing to the observation made on the effect of the peroxide solution in causing separation of dead structures, I have several times used it, since 1864, as a local remedy for diphtheria, in the treatment of which hitherto inscrutable disease I have had the most painful of human experiences. Applied to the throat of diphtheritic patients, the solution of the peroxide, either alone or in combination with glycerine, causes, without any doubt, a rapid separation of the false membrane, and produces a favorable condition of the local surface. But here, I regret to say, the benefit, and it is a benefit, ends. On the general or constitutional conditions it has not as yet, according to present modes of using it, been efficient. It does not touch the collapse. I name this because I see that some writers, on observing its good local effect in cases that have, for some other reason, recovered, speak of the peroxide as nor more nor less than a specific in diphtheria. It has as yet not won that position. At the same time I invariably prescribe it locally in diphtheria, not only to the throat, but as a wash for the nostrils when there is ichorous and offensive discharge. I have hope also of seeing a way to its more successful internal employment.

In Intestinal Affections.—The administration of the peroxide solution as an injection, *per anum*, was a line of practice that occurred to me about 1870 in a case of cancer of the rectum accompanied with a free and very offensive discharge. The action of the solution in destroying the odor, and, combined with tannin, in limiting the discharge, was most useful. Soon after that I was summoned to a patient suffering from what I may designate as strumous caries of the sacrum, with adhesion of the lower intestine and copious escape of pus into the rectum. A more painful case, or one more difficult to manage, I do not remember to have seen. Here I prescribed the ten volume solution, with tannin and dilute hydrochloric acid, by injection with the best results. The disease proved fatal, for the whole of the sacrum was involved before the use of the oxygen solution was commenced, and clear indications of paralysis of the lower extremities had also shown themselves. But the solution exerted such a controlling influence, and rendered the discharge so healthy, I could but regret that the treatment by it had not been brought into action at an earlier stage.

In a case of what was called chronic dysentery, with frequent evacuations of a fluid and offensive character, I prescribed the solution, with tannin, in ounce doses diluted with a pint of tepid water. The injection was thrown into the bowel with a long O'Byrne tube, and as oxygen gas was liberated freely in the intestine soon after the injection was thrown in, evidence was supplied of the presence of purulent fluid, or of some vitalized matter from blood. The result was very satisfactory, and led to such a rapid and sound recovery I can recommend the repetition of the same practice in similar cases with the utmost confidence.

Use by Inunction.—From a knowledge of its disintegrating power I have, for many years, used the peroxide as an inunction for the surface of the body, in patients presenting cutaneous exfoliation, as after scarlet fever and measles. In these instances ozonic ether is used instead of the aqueous solution, because of the facility with which it mixes with the oil or lard required to make an ointment. The body is rubbed from head to foot with the ointment, the spaces between the fingers, toes, and flexures of joints being included. The application is very agreeable to the patient, and the effect in removing obnoxious odors is most marked. But the grand advantage lies in the circumstance that the process seems to remove all danger of infection from the convalescent after three or four applications.

In Eczema.—As a general rule, oily and fatty dressings do not agree well in chronic eczema. But I once gained considerable advantage in treating extensive chronic eczema, which had previously and for a long time been intractable, with this form of ointment. In other eczematous cases, with exudation of blood, I have employed the aqueous solution combined with tannin, or with tannin and a small proportion of tincture of aconite, when there has been much irritation, with equal advantage.

Uses in Diagnosis.—I have found the peroxide of hydrogen, both in its aqueous and ethereal forms, of great service in diagnosis. It diagnoses pus from mucus.

In cases where I am in doubt whether matter expectorated by the lung is or is not purulent, I place the expectorated matter in a test tube containing the solution. If the matter cause no evolution of oxygen, there is no purulent matter present. If the expectoration produces liberation of oxygen, the evidence of pus is strong; and if the same event occurs after all carbonic acid is removed, the presence either of pus or of some plastic element of blood, or cellular tissue element, may be affirmed of a certainty. In the large majority of instances it will be pus that is present.

The diagnosis extends to cellular tissue. Injected into a closed mucous cavity, like the bladder, the surface being in a healthy state, and the viscus having been emptied of urine and washed out with warm distilled water, there is no liberation of oxygen from a neutral solution of peroxide. But if there be any ulceration, by which a surface of cellular tissue is laid bare, or if there be pus present, then the escape of oxygen from two or three ounces of a ten volume solution injected into the bladder will be so free that the gas may be detected as it escapes from the end of the catheter by its relighting a partly extinguished taper. The same test might be applied for the diagnosis of an ulcerated mucous surface, or presence of pus in the uterine cavity, and possibly also the stomach, but no opportunity has been offered me of testing in these last named cases. I may, however, add that no more mischief could follow from the test than would follow from the injection of common water or common atmospheric air, if the solution used be chemically pure; on the contrary, the ozonic quality of the oxygen in solution would have a good effect. It might be sound practice, indeed, to sustain a gentle continuous current of the fluid through the cavity in extensive ulceration of the bladder or uterus, accompanied with offensive discharge.

SUGGESTED NEW PRACTICES FROM PAST EXPERIENCES.

In the course of original research it often happens that a number of side suggestions and thoughts occur to the mind that were not dreamed of when the research commenced. In this way theory is brought out, which, being an induction from experiment, may easily pass into new practice of a valuable character. As a rule it is good for an investigator not to advance theory, even of this order, until he himself has put it to the proof; but there are exceptions to every rule, and here seems to me to be one. Some suggestions leading to important lines of practice have forced themselves on my attention, and call for proofs I can hardly hope to offer in my own lifetime, but which younger men may supply. I, therefore, proceed to state these suggestions without reserve; and this the more readily because in some instances the way toward practice has been opened for a considerable distance with perfect safety.

Suggested Use in Typhoid.—Let me take as a first illustration of this kind an extension of the practice of injecting the peroxide solution into mucous canals. I have indicated, as a practical fact, that the solution can be injected into the alimentary canal, and that in more than one example it deodorized and neutralized an offensive discharge in a most effective manner. I would venture further. I would recommend the practice in the treatment of typhoid. In typhoid it would be possible to throw into the canal, by this means, twenty pints of ozonized oxygen per day by using only one pint of the ten volume solution. The gas when liberated would diffuse through the whole of the canal, and would decompose and oxidize the decomposing exuded products, which, by secondary absorption, are the cause of the relapsing febrile seizures, with an efficiency possessed by no other remedy. It would be like exposing the decomposing ulcerated surface to sea air.

Use for Hypodermic and Subpulmonary Injections in Asphyxia and Chloroform Collapse.—As in the physiological research I found no danger from injecting the neutral solution of the peroxide into the cellular tissue, I have ventured the same on the human subject, and I fully expect that the practice will in time be largely adopted. In asphyxia, as after drowning and after suspended animation from chloroform and other narcotics, a hundred pints of oxygen might easily be transfused, hypodermically, by using the thirty volume solution; and, with the temperature of the solution raised to blood heat, the diffusion of the gas through the cellular tissue would enter the blood rapidly, and tend to give a new force to the circulation. I should even go one step further in such extreme cases. In sudden collapse from chloroform, if the natural respiration had actually ceased, and death seemed to have occurred, I should, to save time, inject the lung substance directly on both sides of the chest with the warm solution. The diffusion of the gas through the lung structure would arterialize the blood remaining in the lung, and the mechanical pressure exerted within the pleura against the elastic lung structure could be made, by up and down piston action, a new motor to the circulation, compressing the blood toward the left side of the heart, and producing a current of blood from the right side.

An Automatic Syringe.—For these subcutaneous and subpulmonary injections of the peroxide, I have invented a syringe which I call the "automatic syringe," and which Messrs. Krohne & Sesemann have very neatly constructed. It is a small graduated instrument, having a feeding tube for charging it on one side and an exit tube for discharging it on the other side. The syringe is automatic in the sense that when both tubes are in place the mere act of working its piston up and down fills it and empties it. The quantities of fluid received and delivered by it vary from ten minims to four fluid drachms, and at the end of the exit tube it can be fitted with injecting needles of different sizes or with a nozzle, according to requirement. With this syringe the peroxide solution can be injected, subcutaneously or into deep structures. By attaching the delivery end to an enema tube it can also be used for the intestinal injection, and by attaching the same end to a catheter, it can be employed for injecting the bladder. The advantage in every case is that the current can be kept up when once it is started, either for a small or large injection, and that the admission of air is impossible. The syringe might be used without any complication for the transfusion of blood and for aspiration as well as for transfusion; but it has been specially adapted for the oxygen solution. There would be no danger of injecting four ounces of the thirty volume solution, rendered neutral, and warmed to the normal blood temperature, into each lung; the water might produce a little œdema, but that would be rather favorable than otherwise under the circumstances, by moderating the oxidation, and the water would soon be picked up, and carried into the circulation by the capillary vessels.

Use in Cavus of the Lung and in Early Stages of Phthisis.—Bearing also on this subject of subpulmonary injection there is another use of the solution which has often occurred to my mind, and which would be perfectly legitimate as a practice, when the powerful action of the peroxide in destroying decomposing and purulent matter is taken into account. I suggest that in cases of cavus of the lung in phthisis, where the cavity can be clearly defined, there would be no risk of injecting the cavity, through a fine needle, with the solution, and of oxidizing all the fluid the cavity might contain. Again, in dangerous hæmoptysis it would be most legitimate practice to inject into the pulmonary structure the oxygen solution saturated with tannin. The oxygen could do no harm, and the tannin, which would be quickly transformed into soluble glucose, would merely charge the blood with a useful saccharine food, with the advantage of making the lung, in a small degree, a kind of second stomach. Still more, it is quite worthy of serious consideration whether it would not be good practice to inject the solution in small quantities by the subpulmonary method in the early stages of phthisis. The oxygen would destroy tuberculous exudation more quickly than any other agent, and I can see no danger of diffusing oxygen through an organ that is made for the sole purpose of receiving and condensing oxygen. The danger of hemorrhage could be met by combining tannin with the solution.

I name this new mode of treating the lung substance the *subpulmonary*, but we may learn also how to transfuse the peroxide solution, without risk and with benefit, into any organ of the body, not excluding the brain and nervous centers themselves.

A Danger to be Considered.

A danger that might arise from injection of the peroxide solution into the tissues would consist of delivering into the tissues so much oxygen *at once* that the blood would not absorb the gas with sufficient rapidity to allow afterward a free course through the minute circulation.

The report of an experiment on this point will illustrate what I mean. A two-necked flask is charged with six ounces of defibrinated blood from an ox. The blood must be deprived of all free carbonic acid by being washed with oxygen. It is of bright arterial color, and if a current of air free of carbonic acid be driven through it into lime water, there is no trace of carbonic acid. But when to this blood neutral peroxide solution is added, there is, even though it be already arterialized to some extent, brisk action. There is further oxidation, there is distinct elevation of temperature, and there is more escape of gaseous matter from the free tube of the flask through the lime water. The gaseous matter escaping consists partly of liberated oxygen, but, as may be shown by the precipitate in the lime water, mixed now with carbonic acid. Thus it is clear that liberation of carbonic acid in the blood circuit from the use of peroxide may occur; and as, within the circuit, there is no means of escape for the gas or gases, there is the same danger as there would be from blowing air into a vein. I observed this fact

*Continued from a research commenced in the year 1856.—*From the Asclepiad.*

while watching the experiment recorded in *Asclepiad*, XXIX., in which I restarted respiration in a lower animal, after death from chloroform, by injecting peroxide solution into the peritoneal cavity. The respiration was so good that life seemed to be returning until the vital functions were arrested from some new cause telling upon the circulation. After death it was found that the right side of the heart and large veins were filled with a bright arterialized blood richly charged with oxygen gas that had been absorbed from the large veins, and with which carbonic acid gas was also admixed. The prevention of this source of danger has to be worked out. It may possibly be done by using a weak peroxide solution, or by using an alkaline solution. Meantime the danger ought to be known and the nature of it understood, since without being understood it might interfere materially with the proper application of the peroxide in its most useful and innocent administrations.

Use in Tetanus and Hydrophobia.—I have spoken of the effect of the peroxide in relaxing muscular contraction, and the facts I have observed in this direction lead me to suggest its use in two particular diseases of the spasmodic type, hitherto so intractable—I mean tetanus and hydrophobia. Any one who has watched the course of one at least of these diseases (tetanus) will feel that the treatment most of all hopeful, if it could be realized, is a means for preventing the muscular tetany, for producing free glandular elimination, and free oxidation of the septic blood. In the peroxide solution we have all the requisites; and in the next case of tetanus that comes under my care it is my intention to put the remedy to the completest trial. I shall inject the muscles, in groups, with the neutral ten volume solution, heated to blood temperature, adding, if the oxygen be not alone efficient in reducing the tetanus, a weak alcoholic solution of amyl nitrite.

Mechanical Use.—One other purpose for the peroxide must be named; a purpose purely mechanical, and yet not to be slighted. In the process of being liberated from its solution the gas exerts an expansion, which in many instances may prove of great service. In this mechanical mode the solution could be used in obstruction of the bowels from intestinal involution. It could be used for causing distention of the bladder when the sound was being employed; and perhaps in stricture for producing dilatation of the passage posteriorly to the stricture. In the same manner it could be brought into play for dilating the uterine cavity; while for bringing on premature labor, in instances of contracted pelvis, the effect of the equal distention by the gas liberated from three or four ounces of the ten volume solution would, I suspect, be as rapid as it would be safe and effective.

Use as Spray.—I reported in my last paper that, taking advantage of the ozonic qualities of the peroxide, I introduced it, in 1865, at the meeting of the British Medical Association at Chester, for deodorization and disinfection of the air of rooms in which patients suffering from infectious diseases are under treatment. I employ it in these examples in the form of spray, and I know of no agent of the kind that is so effective. It communicates to the air of the room the best characteristic of seaside air; and it would, I am sure, be of special service in the air of wards containing patients suffering from phthisis pulmonalis. In such wards it could be arranged to be distributed automatically, at particular and fixed hours, by means of a clockwork that would turn on a tap for a few minutes, and close it when the proper quantity of spray necessary for diffusion was distributed. The same plan could be adapted to surgical wards; and in private practice it might be applied to the sick room. For these purposes Messrs. Krohne & Sesemann have invented a most effective spray producer, which works at a moment's notice and for long periods diffuses the spray, through a room or ward, in finest state of distribution.

SUPPLEMENTARY CLINICAL NOTES.

The interest taken in the use of peroxide of hydrogen in the treatment of disease has led me to add one or two supplementary notes before proceeding to the pharmacological chapter, with which I propose to bring this essay to a fourth and concluding part in next *Asclepiad*.

Use in a Case of Pleuro-Pneumonia.

During the immediate past quarter I have had under my care a medical friend suffering from acute pleuro-pneumonia. The attack was most severe, was attended with 5° F. of fever, and passed on to the formation of circumscribed pleural abscess, with rupture of bronchial tube, expectoration of purulent matter, and all the usual concomitant symptoms of purulent formation, febrile excitement and exhaustion followed by free perspiration. At this stage I prescribed the use of the peroxide, by inhalation, in combination with anhydrous ether. To carry out the intention, I fitted up an apparatus consisting of a pint globe of strong glass, having two necks. Into one of these necks a glass funnel, armed with a glass tap, was inserted. Into the other neck I fitted the end of an India rubber tube, four feet long, and three-quarters of an inch in diameter, terminating in the old double-valved chloroform inhaler mouthpiece, commenced by myself, improved by the late Dr. John Snow, and completed by the late Dr. Francis Sibson. The gas globe was charged with ten ounces of the thirty volume solution of the peroxide prepared by Messrs. Robbins, of Oxford Street. On the surface of the solution two fluid drachms of anhydrous ether were poured, so as to form a film of ether over the surface of the solution. When the administration had to commence, two ounces of a solution of permanganate of potassa, containing five grains of the permanganate salt to the ounce of water, were put into the funnel and allowed to pass gently into the peroxide solution beneath. As the two solutions came into contact and commingled, oxygen was freely given off, and passing through the ether, yielded an ethereal atmosphere, which the patient readily inhaled from the mouthpiece. Both the chemical solutions, the manganese and the peroxide, supplied oxygen, and the liberated gas in passing through the film of ether, a part of which it carried away with it, was ozonized. The gas was pleasantly ethereal to inhale, and very soothing for the cough, acting in fact after the manner of an anodyne. The patient quickly learned how to administer to himself the proper dose, one single lesson in administration being sufficient to show to him two tests by which it is known that the supply of the oxygen is exhausted, one test being the cessation of the taste of ether, the other the discoloration of the bright red permanganate solution. He administered the gas to himself in the quantities named above every four hours at first, reducing the number of administrations, after the third day, to every six hours or eight hours, according to symptoms, until it was no longer required.

The action of the inhalation in this case was without exception the most satisfactory I have ever witnessed. Under it the cough was rapidly controlled, the exacerbations declined, pain was relieved, and the expectoration of pus ceased, with disappearance of the physical signs of purulent exudation. We had naturally dreaded extensive empyema, the necessity, perhaps, of operation of tapping the chest, and a prolonged recovery. Happily, all these anxieties were saved, and in a few weeks convalescence was complete.

Use in Gonorrhœa.

I had occasion during the past quarter to prescribe the solution in a case of gonorrhœa, at a time when a troublesome purulent discharge was passing into gleet. A variety of injections, including one of nitrate of silver, had been employed, but without any controlling effect on the discharge. The injection I prescribed consisted of the solution of the peroxide (ten volume strength and of neutral reaction), one fluid ounce; tannin, ten grains; distilled water, three fluid ounces. To make an injection of four fluid ounces, of which half a fluid ounce was to be injected twice daily. Within a week the discharge had entirely ceased, and now, ten weeks later still, has not returned. The patient said that the first injection caused a little smarting, followed by the escape from the urethra, as he withdrew the syringe, of some frothy and rather "sticky" fluid; but afterward the fluid became less tenacious, more watery, and at last seemed to consist of the fluid he had injected only, evidence, as I took it, that there was no remaining pus, and that further injection was, therefore, unnecessary. The correctness of this view was confirmed by the result.

Some Reported Clinical Results.

Several correspondents have written to me during the quarter on points relating to the employment of the peroxide:

Dr. O'Rorke, of Crossakiel, Co. Meath, consulted me by letter respecting a case of *rupture of the vagina* that had occurred during labor, and from which there had ensued much pain and offensive discharge. My correspondent, who detailed the symptoms with the greatest care, was anxious to know whether I thought the peroxide solution would be of service. I replied affirmatively, and added a word or two as to the best method of application. He carried out the practice at once by employing the peroxide solution of ten volume strength, diluted with equal parts of water that had been boiled, and charged with five grains of tannic acid to ten ounces. The solution was kept applied to the affected part by means of sponges, and the effect, he reports, was so completely satisfactory that a healthy healing, which commenced immediately, was completed within twenty-four days, leaving a firm union of the lacerated parts.

Mr. T. Edward Williams, of Talgarth, Breconshire, has sent me particulars of a case in which a patient suffering from *strumous disease of the ankle joint*, with several sinuses, was doing favorably under injections of solution of the peroxide of five volume strength, but who, upon changing the solution into one of ten volume strength, began to suffer from malaise, with a rash on the skin, and sympathetic swelling in the opposite ankle. Mr. Williams wished to know if I had encountered any similar experience. My reply to this inquiry is that I have seen no such symptoms following upon the use of the peroxide in any form, and that the symptoms were probably of constitutional rather than of local origin. At the same time, the fact should be remembered, with the object of noticing whether under active local oxidation of dead purulent matter near to living tissue any secondary product may be produced which may give rise to constitutional disturbance.

(To be continued.)

ON POSTURE AND ITS INDICATIONS.

By T. LAUDER-BRUNTON, M.D., D.Sc. Edin., F.R.S., etc., Assistant Physician and Lecturer on Materia Medica and Therapeutics at St. Bartholomew's Hospital.

IN a former paper* I observed that I thought medicine lost a great deal by its practitioners either not recording their experience at all or not recording it in such a form as to be readily available for their fellow practitioners, or with sufficient precision to be really useful.

As examples of vagueness and precision I instanced a verbal description of a face as commonly given, and a sketch containing all the features more or less precisely drawn.

In the present paper I have tried in a very imperfect way to indicate the common postures which one meets with daily, either in patients or others, and to discover the reason why those postures are assumed. I have not attempted to draw the figures, for this would have been beyond my powers, and probably also beyond the powers of many medical men. I have simply indicated the position by a few simple lines such as any one can draw.

This method is one which was employed with great success by the late Professor Goodsir more than thirty years ago in illustrating his lectures on anatomy. In a few lines he conveyed the impression of the agility of the cat as compared with the heavy movements of the ox or of the elephant, and the absence of detail fixed the minds of his students all the more firmly on the main facts, which he wished them to carry away. As we walk along the streets and notice the difference of attitude in the passers-by, some with head erect and agile steps convey to us at once the idea of energy and activity (Fig. 1), while others with hanging heads and bended knees suggest the ideas of languor, weakness and depression (Fig. 2).

It is a matter of ancient observation that such an attitude as this is associated with weak circulation, and it is probably more than 3,000 years ago that the injunction was given: "Strengthen ye the weak hands and confirm the feeble knees; say to them that are of a fearful heart, Be strong, fear not." Is. xxxv. 3, 4.*

FIG. 1.

FIG. 2.

When the heart is stimulated by joy or hope, the attitude again becomes erect and the gait brisk and elastic. It is by no means easy to distinguish exactly between the part played in this change by the motor cells of the nerve centers and by the circulatory apparatus, for the activity of the motor cells on which muscular action depends is itself influenced to an enormous extent by the circulation of blood through the nerve centers. We find an example of this in the attitude unconsciously assumed by any one engaged in conversation or argument.

So long as he takes only a listless interest in the subject under discussion he may lie back in the chair with his legs crossed and his arms either hanging down or his hands laid loosely in his lap (Fig. 3). As his interest increases his attitude becomes more erect (Fig. 4), and

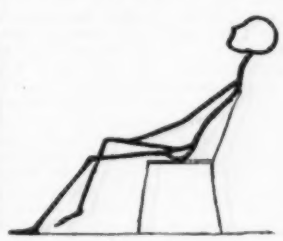


FIG. 3.

FIG. 4.

he sits straight up, with his hands folded or laid upon his knees, instead of hanging listlessly down (Fig. 5). As the interest increases still further the body is bent forward at an angle and the hand is very probably placed firmly on the thigh (Fig. 6). If he becomes ex-

FIG. 5.

FIG. 6.

cited in the heat of argument, the body is bent forward at a somewhat acute angle and the hand is stretched out in front and somewhat upward, as if to help the words which flow from his lips to drive the thoughts which are rapidly evolved from his brain into his opponent's mind (Fig. 7).

FIG. 7.

In this position the flow of blood through the arterial system onward to the brain as well as its return backward through the veins seems to be particularly easy (Fig. 8).

FIG. 8.

This position is not only assumed during the heat of argument, whether the speaker be sitting or standing, but when one is led to assume it unconsciously it seems

to give rise to a rapid and sometimes almost uncontrollable flow of ideas. Thus it occasionally becomes a cause of remorse to devout souls, who during the attempt to pray in church in this attitude are sadly distracted by crowds of ideas, which at once disappear on the assumption of an easy sitting posture. The circulation in the cerebral vessels and the current of ideas in the brain are very delicate things and may be modified by very slight causes. Thus an attitude with the head drooping slightly more than that indicated in Fig. 6 and with the chin supported upon the hand is the one frequently assumed in deep thought, with concentration of ideas upon a single subject and no desire for immediate expression (Fig. 9). The touch of the hand

FIG. 9.

FIG. 10.

upon the head seems to have a directing power over the thoughts which one would formerly have been inclined to deny, but such experiments as those of Tesla and Crookes with electric currents of very high tension give a visible illustration of phenomena previously unknown and seemingly incredible. For in these experiments a person who has put himself into the electric field renders vacuum tubes containing various substances fluorescent and fills them with a glow of colored light by simply waving his hands over them. The tubes, which were previously dark, owe their luminosity only to the approximation of his hand, yet he himself does not feel that any special power has gone out of him. The contact of the hand with the temples seems as if it could hardly by any possibility modify the circulation in the brain or the feelings of the individual, and yet it appears to have an actually soothing effect and to be a real physical solace in cases of grief and depression (Fig. 10). At the same time the greater droop of the head possibly provides for a better supply of blood to the sensory parts of the brain in the posterior part of the head, and thus to a certain extent counteracts the general weakness of the circulation. In the case of excitement (Fig. 7), the head being more raised, if a straight line were drawn through the axis of the body so as to represent the line of the aorta and carotid arteries, it would come out at the anterior part of the head; and blood driven onward in this line would supply nutriment rather to the motor than to the sensory centers.

In cases where the circulation is exceedingly weak and syncope is threatened, a most useful plan is to make the patient put his head down between his knees (Fig. 11), so that an ample supply of blood shall reach

FIG. 11.

the cerebral centers. Long ago, before the introduction of anæsthetics, a common plan of rendering patients senseless previously to the performance of an operation was to lay the patient flat upon his back and then suddenly hoist him to a standing posture by six strong men who held him by the arms, three on one side and three on the other. The brain being thus, as it were, lifted away from the blood, became so anæmic that it ceased to act before the circulation could adapt itself to the new posture.

An experience of my own once showed me how very dependent the brain is upon the supply of blood. I was called upon one night after a long day's work to write an article immediately. I sat down with pen, ink and paper before me, but not a single idea came into my head, not a single word could I write. Lying back, I soliloquized: "The brain is the same as it was yesterday and it worked then, why will it not work to-day?" Then it occurred to me that the day before I was not so tired and probably the circulation was a little brisker than to-day. I next thought of the various experiments on the connection between cerebral circulation and mental activity, and I concluded that if the blood would not come to the brain, the best thing would be to bring the brain down to the blood. I laid my head flat upon the table and at once my ideas began to flow and my pen began to run across the paper. I thought, "I am getting on so well I may sit up now," but the moment I raised the head my mind became an utter blank, so I put my head down again flat upon the table and finished my article in that position.

Stimulation of some branch or other of the fifth nerve seems to increase the circulation in the brain, and those who are making their utmost calls upon their mental powers are accustomed to stimulate this nerve in one way or another. The late Lord Derby used to eat brandied cherries, and an experiment of Marey's (Fig. 12) proves that mastication will accelarate the flow of blood through the carotid artery, and serves to show the wisdom of an editor whom I knew who used to eat figs while writing a leader, and even of those who indulge in the practice so disagreeable to their neighbors of chewing tobacco. Others stimulate the gustatory branches of the fifth nerve by the sweets which they suck or by the smoke of a cigar or cigarette; while a pastie called upon suddenly to answer a question will probably excite the cutaneous branches of this nerve by scratching his head, and a man of more culture may stroke his mustache or beard, press his forehead or eyes, or, like many Germans, smite his nose with the forefinger.

A similar reason may be given to explain the habit of snuffing formerly so much in vogue. The gentle titillation of the nasal mucous membrane by the snuff probably serves to stimulate the cerebral circulation, and the increased arterial tension due to the efforts of sneezing so increases the cerebral nutrition that difficulties seem at once to disappear and obscurities of mental vision are so rapidly removed that snuff is said in popular language to "clear the head." The practice of snuffing has fallen to a great extent into disuse, but it may still be occasionally employed with advantage in cases of severe and persistent headache where other remedies fail to relieve. Even where such a strong irritant as snuff is not resorted to, smelling salts (sal

FIG. 12.—Tracing of the rate of circulation in the carotid. After Marey.

volatile) or aromatic vinegar may give considerable relief in headache if frequently inhaled.

While stimulation of the fifth nerve as just described tends to keep people awake and increase their mental activity, gentle, rhythmical stroking of the head tends on the contrary to make them fall asleep, and brushing the hair has this effect on many people to such an extent that the movements of the hairdresser's fingers over the scalp and rhythmical click of the shears will send some people to sleep, even at the risk of having their hair shorn to a much greater extent than would be at all pleasing to them on awakening. A gentle rubbing of the scalp, as if to loosen it upon the skull, also tends not only to soothe irritability, but to relieve and to prevent headaches.

External temperature has a powerful effect in determining posture. On a hot summer's day the natural tendency is to lie down with the head slightly raised, the arms hanging loose and one leg extended, while the other perhaps is drawn up, as in Fig. 13.

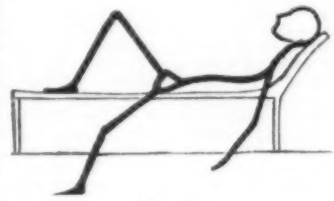


FIG. 13.

FIG. 14.

The physiological reason for this posture is that in it the greatest extent of cooling is attained, for it insures the greatest possible exposure of the largest vascular district in the body—viz., the intestinal vessels—to the cooling influence of the external air. This is aided by the loss of heat due to the evaporation of sweat. By the slight raising of the head and the drawing up of one leg the abdominal parieties are rendered loose and the intestines tend to fall sideways and the abdomen tends to become flattened from before backward. The greatest extent of cooling surface is thus obtained and the temperature of the body is kept as low as possible.

An entirely opposite attitude is assumed when the external air is cold (Fig. 14). The thin abdominal walls being insufficient to protect the intestinal vessels from the cooling influence of the external air, the legs are drawn up until the thick muscles of the thigh form a warm covering to the abdomen and thus prevent loss of heat from the intestinal vessels. Many people are unable to get to sleep when they are at all cold, and Rosenthal has shown that this attitude is commonly adopted by men, dogs and other animals when preparing to sleep, so as not only to maintain the bodily temperature during sleep, but to allow the intestinal vessels to dilate and accommodate a mass of blood which would otherwise be driven into the cerebral circulation, stimulating it to functional activity and keeping the person or animal awake.

The attitude of the body may be altered permanently by occupation or disease in such a way that one accustomed to pay attention to this subject can frequently make out with a little trouble a good deal regarding the patient's history and illnesses. Thus a chronic cough has the effect of inflating the chest and rounding the back, so that one might almost guess from the figure (15) that the person so shaped was

FIG. 15.

liable to chronic bronchitis. The more tightly a bladder is blown up with air the more tense does it become and the more does it take a circular form. In the same way the more an alveolus of the lung is blown up by the efforts of coughing the more does it resemble the inflated bladder. What is true of a single alveolus is true of the chest as a whole. It tends as nearly as possible to become globular, with a circular outline not only in the transverse, but in the longitudinal direction. The sternum and vertebræ prevent it from becoming completely globular, notwithstanding all efforts, and it thus assumes the barrel shape so characteristic of emphysema, as being the nearest possible approach to a globe. In going through a hospital ward one sees here and there patients who are constantly sitting up in bed and do not lie down at all; these are for the most part people who have great difficulty of breathing. The reason for this position has no doubt been often given, but I do not recollect coming across it in print, and I cannot say whether the reason that I now give has been evolved from my own brain or whether I have learned it from others.

When a man is sitting upright the diaphragm moves up and down during respiration (Fig. 16). At each

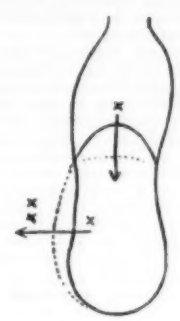


FIG. 16.

inspiration it descends and displaces the intestines and the abdominal walls outward. During each expiration the diaphragm ascends, and the intestines and abdominal wall return back to their former position. In the upright posture the diaphragm moves vertically, but the abdominal walls and intestines move in a horizontal plane and there is no lifting work for the diaphragm to do. The case is quite different when a man is lying on his back, for then the diaphragm moves in a horizontal plane and the abdominal walls and intestines in a vertical one. During inspiration, as the diaphragm encroaches on the abdomen for the purpose of enlarging the thorax (Fig. 17), it has actually to raise the intestines and

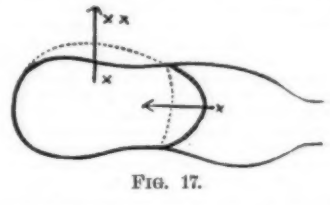


FIG. 17.

the abdominal walls, instead of merely moving them in a horizontal plane. As the diaphragm returns into the throax during inspiration, its progress will be accelerated by the weight of the descending intestines, and thus the recumbent posture may be sometimes useful in cases of bronchitis with emphysema, and so such cases may be seen sometimes lying down, although there is considerable interference with the aeration of the blood. In cases of cardiac disease no benefit of this kind is obtained, and therefore we find that a large proportion of those whom we see sitting upright in bed in a hospital ward are suffering from disease of the heart.

When a patient lies upon his side the intestines also move in a horizontal plane, and this is the position usually assumed during healthy sleep, for in it there is no interference with expiration any more than when the patient is sitting upright, while at the same time the rest obtained is much more complete. The side upon which one lies is immaterial to most healthy persons and they frequently lie first upon one and then on another, turning over perhaps several times in the course of the night; but in cardiac disease or cardiac irritability without organic disease patients frequently are unable to lie upon the left side, because the heart beats against the ribs with such force as to cause physical discomfort. At the same time the heart itself appears to be stimulated by the blows which it gives itself against the thoracic walls and to palpitate more violently than before. The patient is therefore obliged to lie upon the right side. A similar result may occur if the liver is enlarged or congested, for then it seems to drag upon the suspensory ligaments when the patient lies upon the left side, and thus he is obliged to turn round that the liver may be supported by the ribs. If a heavy meal has been taken shortly before retiring to rest, the person may be unable to lie upon his left side, because the stomach drags upon its pyloric end.

On the other hand, if the stomach is distended by flatulence, the gases sometimes will not escape while the patient is lying on his left side, and he must either be raised into the sitting posture or be turned on his left side to allow the gas to eructate by the œsophagus and the tension in the stomach to be relieved,* for the œsophagus joins the stomach at such an angle that when the patient is on his left side the gases appear to accumulate and not to find an exit through the œsophagus, but when he is on his left side they pass upward with comparative ease. This of course is a matter of very slight moment to patients who are able to move readily, because they adjust their own position at will and soon find out which is the most easy one for them. But when a patient is so weak that he is unable to move himself, he is frequently allowed to lie flat on his back and to suffer much from abdominal distention and even from difficulty of breathing, due to the diaphragm being pushed upward, when he might be relieved by simply sitting him up for a few minutes or turning him over on his left side.

In this short paper I have made no reference to many

* I have found this practice useful. The explanation I have given of its utility was, I think, suggested to me several years ago by John Haldon, M.A., M.D.

other postures in disease, neither have I attempted to discuss the postures due to trade, nor have I attempted to make the paper complete. I have merely tried to give an illustration of an easy method of recording posture in a tolerably precise and easily understood way, and have attempted to connect external signs with physiological conditions as an illustration of the method of tracking which I mentioned in a former paper, in the hope of inducing others to prosecute the same line of work.

IMPROVEMENTS IN MICROGRAPHY.

By HENRY G. PIFFARD, M.D.

THE act of micrography, or the reproduction on paper of images of minute objects seen through the microscope, may be practiced in various ways, of which the three following are the principal:

1. The observer studies the object on the slide, and, when he thinks he has the outlines and details, or a portion of them, sufficiently impressed on his mind, withdraws his eyes from the tube and commits the mental picture to paper, using, of course, both eyes in directing the movements of his pencil. Success with this presupposes a retentive memory and considerable skill as a draughtsman.

2. The observer, looking down the tube in the usual way with one eye—for convenience, the left—is, after a little practice, enabled, by a sort of auto-projection, to see an image of the object on a sheet of paper by the side of the microscope. The outlines of this image he traces with the pencil, using the right eye to direct his movements, the observation and the reproduction being simultaneous.

3. By the aid of a camera lucida, of which there are many different sorts, a reflected or projected image is visible on the paper with the eye that is at the same time occupied in directly observing the magnified image of the object on the stage. In one of the latest forms of camera lucida—the Abbe—this use of half the eye for observing, and the other half for recording, is a reasonably convenient method if the observer's eye is approximately normal; marked myopia or hypermetropia, and still more pronounced astigmatism, necessitating the use of spectacles, render the use of the camera lucida inconvenient, if not well-nigh impossible.

Some time since it occurred to the writer that the practice of micrography could be greatly simplified by adapting the principles employed in ordinary projection, as used in connection with the optical lantern, the projection microscope, photo-micrography, etc. It was only a question of reflecting the projected image on to a piece of drawing paper fixed in some convenient position. To this end I requested Messrs. Bausch & Lamb to mount a right-angled reflecting prism with a short tube extending from one of its square faces, this tube to be of such a caliber that it could be inserted into the microscope in the place of the eye-piece. From the other square face a similar short tube extends, capable of receiving the ocular and holding it firmly.

When preparing to use this device, the object is placed on the stage and focused in the usual manner. The microscope is then brought to a horizontal position, the eye piece is removed, and the prism case put in its place, the ocular being inserted in the short tube provided for its reception. The ocular should point downward. The lamp, or other source of light, should then be disposed in such a way that it properly illuminates the object to be examined, it being expressly understood that no light shall escape toward the observer except that which first reaches the object. A Beck lamp is conveniently adapted to this purpose. If a piece of drawing paper is placed beneath the ocular and the room darkened, a brilliant image will be projected on the paper, and its reproduction with the pencil can be accomplished with a maximum of rapidity and a minimum of discomfort. In guiding the pencil the draughtsman uses both eyes, and his spectacles if needed, and sits in whatever position he finds most comfortable. The general disposition and arrangement of the apparatus will be readily understood by an examination of the accompanying cut, Fig. 2.

With a proper lamp and careful utilization of its light, this device gives excellent results with amplifications up to four and five hundred diameters.

If a sensitive photographic plate be substituted for the drawing paper, an exposure of a few seconds will impress an image that may be developed in the usual way.

An Improved Means of Obtaining Critical Illumination for the Microscope.—Critical illumination is that sort or kind of illumination which best conduces to the revelation of the intimate structure of microscopic objects. The illumination is said to be "critical" when the image of the radiant (lamp-flame or other source of illumination) is brought to a focus by mirror or condenser at the plane of the object under examination. Skilled microscopists are pretty well agreed that the most convenient and feasible means of obtaining critical illumination is by focusing the edge (not the flat side) of a half-inch kerosene flame on the object.

The writer is unable to use with comfort either gas or an oil lamp in microscopic work, but has found that he can work by electric light for several hours continuously without inconvenience. Attempts to obtain satisfactory critical illumination from this source have occupied a portion of his time during the past two years. Without referring to the devices he has abandoned, he will simply describe the one at which his experiments have terminated, leaving to others the opportunity to still further improve it.

The ordinary electric lamp in domestic use has an illuminating value of sixteen candles, and its thread-like filament is brought to incandescence by a current having an intensity of about half an ampere under a pressure (in the Edison system) of from one hundred and fifteen to one hundred and twenty volts. The light is distributed over a filament about five inches in length. Such a light is not a desirable one for microscopic work. It would be much better to have the light more condensed by the use of a shorter and thicker filament. There is no difficulty whatever in constructing such a lamp, but if it were brought directly into the Edison circuit, its life would be exceedingly brief; in other words, a certain length of filament is required to withstand the pressure of the current from the main. Two things, then, are needed: First, a lamp with a short and thick filament; and, second, a means of properly connecting it with the street service.

Having decided on the character and form of lamp desired, I applied to the Edison Lamp Works to have it constructed according to the plans and specifications which I furnished. These were carried out as requested, and the result was a lamp of fifteen candle power requiring a current of about three amperes under a pressure of fifteen volts.

The lamp in question possessed certain peculiarities of construction.

The glass bulb, instead of possessing the pear-shaped form usually met with, is cylindrical and about three inches in length by an inch in diameter. At first glance the carbon filament would appear to have the ordinary horseshoe form, and to be of the usual length (four to five inches). A closer inspection, however, shows that the carbon is actually but three-quarters of an inch in length, while the rest of the apparent filament is composed of copper wire, arranged so as to hold and support the carbon in a vertical position. It

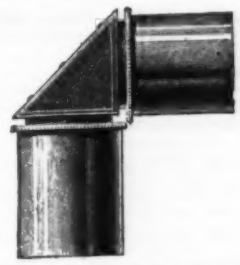


FIG. 1.—THE AUTHOR'S DRAWING PRISM.

will also be noticed that the carbon is much broader and thicker than in the ordinary domestic electric lamp. When this carbon is rendered incandescent by the passage of a suitable electric current, we will have, when the lamp is in position, a vertical streak of light of intense brilliance about three-quarters of an inch long and apparently an eighth of an inch wide. The minified image of this is focused by a mirror or condenser on the object we desire to examine, and constitutes "critical" illumination. If now we proceed to the examination of the object with, for instance, a quarter of an inch objective, we observe that the field is not evenly illuminated, but, instead, a central brilliant streak, on each side of which the light is comparatively feeble. The portion of the object within the area of the streak is now illuminated in the manner most favorable for the revelation of its intimate structure. In systematic work critical illumination is rarely called for except as a means of control, and subcritical or diffuse illumination, as obtained by racking the condenser a little out of focus, is preferable and more commonly employed. The lamp here described furnishes a light for ordinary work which in many respects is preferable to any I have heretofore employed.

While this fifteen volt lamp can be readily maintained at full incandescence by the current from an eight cell storage battery, the care of this latter is by no means an insignificant matter; and I am not prepared to recommend its use unless one has access to one of the street circuits. In this city we have at our disposal either the Edison circuit, with a pressure of from one hundred and ten to one hundred and twenty volts, or the alternating current, distributed to houses under a pressure of fifty-five to sixty volts. If the fifteen volt lamp be connected directly with either of these circuits, it would be instantly destroyed. It is necessary to neutralize or take up a portion of this pressure by the introduction of a suitable resistance. This can be conveniently accomplished on the Edison circuit by the interposition of a hundred candle power, one hundred volt, three ampere lamp of the "*municipal*" type, the two lamps being connected in *series*. Both lamps will, when thus arranged, burn at full incandescence; but, as we do not desire to employ the larger lamp, this may be placed under the table and covered with a box.

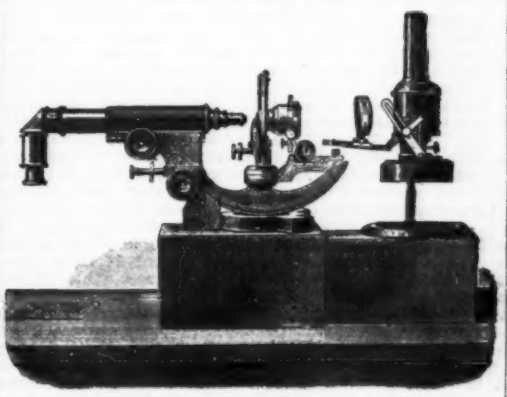


FIG. 2.—SHOWING LAMP, MICROSCOPE, AND PRISM IN POSITION.

In photomicrography the writer has made use of nearly all the methods of artificial illumination that have been proposed, including the electric arc, electric incandescent with coiled carbon of one hundred candle power, calcium light, Welsbach gaslight, and kerosene oil. The lamp here described he finds infinitely more convenient and amply efficient.

For the study of absorption spectra by means of artificial light, this lamp gives an ideal illumination.—*N. Y. Med. Jour.*

ON COLOR HARMONY.*

By E. H. KELLY.

THE subject of color is such a vast one that I can only touch on a few of the main points under consideration.

We start with sunlight as the basis of all color. It is said that no such thing as color exists in material, it is simply the action of sunlight on material.

Color is composed of molecules similar to particles of sand. When the particles are of such a shape or form that all of the rays of light pass through like a sieve and are lost we term it black; when the particles are of such shapes that they stop all of the light rays and reflect them to the eye, we term the material white.

The general divisions of rays are of three kinds, red, yellow and blue, white and black not being termed colors in their true sense.

I have here five paints, white representing sunlight, black indicating darkness or night, also red, yellow and blue, the primary colors. The definition of the word primary, as I understand it, is anything that is contained in and of itself, a something that exists in its purity in nature, and cannot be made or compounded of other matter or material or substance.

A perfect blue, for instance, is ultramarine, which is a substance found in a perfectly pure state in lapis lazuli, a stone found in many parts of Asia.

To obtain the small particles of color the stone is pulverized and mixed with a strong resinous paste, which adheres to the stone without adhering to the grains of color.

By washing the paste in water the color is separated from the stone, pure, manufactured as it were by nature's chemist, requiring only to be ground to be ready for the market.

Beginning with the three primary colors, red, yellow and blue, which if we lap over each other as in the rainbow, or mix as the painters do, we produce three other colors, violet, green and orange, called secondary; by lapping these, as above, we produce three other colors, russet, citrine, and olive, termed tertiary colors. These three sets of nine colors, with their hues, tints, and shades, comprise every known color.

I will produce a few of these colors to demonstrate that the entire color scheme originated from the three primaries, black and white not taken as colors.

With red the first secondary or compounded color is orange, which is a combination of any and all proportions of red and yellow; its contrasting color is blue. The contrasting color is always the primary that is not contained in the secondary. Thus (2) violet made of red and blue, is contrasted with yellow, (3) green made of blue and yellow is contrasted with red.

Tertiary colors are composed of all three primaries, while the secondary colors are made of any two primaries. A perfect tertiary color has two parts of any one primary with one part each of the other two primaries.

In tertiary colors where red predominates it is termed russet, colors where yellow predominates are termed citrine, colors where blue predominates are termed olive.

Tertiary colors have no colors which are contrasting. Harmony with them should always be in tints or shades of the same tertiary. But where it is necessary to use another color, always use the color that is farthest from tertiary in the rainbow; for instance, where russet is used take the extreme opposite side of the rainbow or blue, for it is the nearest to contrasting harmony with russet.

The general modifications of colors are hues, tints and shades.

Like natural ultramarine or English vermilion, neutral hues are composed of neutral gray and hues.

Neutral gray is any and all proportions of white and black, which when half and half is termed pure gray or neutral.

Do not confound "gray," a neutral, with "gray," a tint of blue.

We will call English vermilion pure in hue. Now if we mix pure gray with it, we will have pure neutral hue of red. It is not a shade, although it looks dark.

Hues are neutral as above, while shades are produced only by adding black to color. Secondary and tertiary hues are produced by the same method as above.

Tints are of two kinds, pure and neutral. A pure tint is pure white added to a color, a neutral tint is a neutral gray, in which the white predominates, added to a color.

Shades as above are pure and neutral. Pure shade is only black added to a color. Neutral shade is gray with black predominating, added to a color.

Among the paint trade the terms pure and neutral hues, tints and shades are all confounded or mixed up. Observe that the pure has a clean look while the neutral has a smoky or dead look, most noticeable in the foggy or misty hues of light blue.

The question as to what constitutes what is called color harmony has been the great unsolvable mystery of the painter's and decorator's trade ever since color has been known. I have studied all the books obtainable and have made experiments, with the result that color is governed by the same laws that control the science of sound, as in musical harmony.

If we hear any sound, as a car whistle, that gives a tone on one or more pitches, should the tone be very low in pitch, we hear distinct puffs.

As the pitch rises the puffs join each other, and we hear a sound in which the puffs appear like ridges, ever increasing in rapidity as the pitch rises, until lost to the ear at about the pitch of middle C on the piano.

Puffs and tone ridges are the result of equal vibrations of the air, both in volume and time, while discord of tone is unequal vibrations of air.

Color is caused by ether waves, while sound is caused by air waves. Any material, single or compounded, that will cause the ether waves of light to vibrate in regular order and not cross, conflict, and interfere is in harmony. For instance, I take this white card, 20 × 28 inches. It looks clear, clean on the face, the edges look straight and true. This red or green card also appears clear and clean.

We call that harmony, because the ether waves do not conflict or interfere; in other words, when colors are in harmony, they appear stationary.

* A recent lecture before the New York Master Painters' Association.—From *Painting and Decorating.*

But if these color cards were in discord and the card was say ten or twelve feet long, the edge of the card would appear to wave like serpentine braid or snake fashion.

You let your eye follow up and down the edge of this door casing or along this picture moulding and notice the waving movement, the worse the discord the larger the wave. If the surface of a plastered wall is painted in harmony it will appear clear and clean, as though the paint is well ground or mixed, and laid by a good workman, but if in discord, you will feel like blaming the workman the first thing, for not laying the paint even. Then the plaster is uneven in grain and shows the paint darker where the trowel left a circular grain in a different direction. Dark, moving or muddy spots are discords of color and not poor workmanship.

It is the conflicting or interfering of the ether waves.

Place two of these cards side by side, each of a different color; if they are in discord the crack between them will appear waving; one card looks darker at the joining edge while the other looks faded; this red card with the orange one is in discord.

The red looks dark at the edge and spotted on the surface, the orange looks faded out to almost a yellow. If the colors are clean and stationary, we have individual harmony or self-tones.

To arrange colors for individual harmony, take any color desired and add white or black in any proportion. The color in all its tints and shades will always be in harmony with each other. It does not change the harmony of any color by adding white and black, as they represent daylight and darkness. Therefore, if I should turn down the lights, or carry this red card away from the light into darkness, the red would appear to change its color to all the shades of dull red and brown down to black, as it was removed from the light. The same principles are developed in tints by adding white to color, the color is the same, so that it is always correct, in every case, to use any two or more tints or shades together.

Individual harmony is harmony of itself or self-tones.

Blending harmony consists in blending any two colors together that will not form a new color at their lapping.

Will any gentleman present mention any color that will blend with this red, and not form a new color? I want to blend with red to demonstrate; but remember that colors that blend perfectly are in discord if used for contrast. (*No color is offered.*) Take orange and red. It is perfect blending and also perfect discord by contrast. The rainbow colors in their regular order are all perfect in blending harmony, and also the extreme of discord, when used in full or strict colors.

Probably the best example of blending is with blue and green, as there is not the remotest hue, tint or shade of another color seen.

Contrasting harmony is the one to be most carefully borne in mind by the painters.

Start here at red with tints and shades; the red is always in perfect harmony with the two other primaries mixed together (yellow and blue), making green, of which there are hues, tints and shades innumerable—probably 20,000 or as many as the human eye can distinguish a difference in.

Here the lecturer demonstrated color harmony by placing borders, about three inches wide, having an open center about four inches square, the borders of different colors, around various colored squares about 4 × 4 inches.

Placing red border around a green square. I would like to have you gentlemen see if this green appears clear, clean and stationary; observe the effect when I place this red border around it.

Mr. Lorton.—It brightens it up.

Mr. Kelly.—Never place two colors side by side that have the same primary color in their composition and you will never have a discord.

A very simple method that every one can remember how to find out the color, if you have already some of the paint mixed, is to take a piece of white card or paper, and drop one large drop of the paint you have mixed near the center of card, and the paint will form an oval mound or paint mirror.

Hold the card in the sunlight and look at the paint drop about twenty seconds without winking. Around the drop will appear a color halo of the color required, like the light halo that encircles the moon. The stronger the light the whiter the card, and the brighter the paint drop the stronger will be the halo found. If the halo does not appear at once, look away from the drop to the card and a halo will appear on the card. Or look at the drop and close the eyes instantly and then the halo will appear in the darkness.

If the paint is composed of all three primaries, no halo will appear.

Red has a green halo, yellow has a violet, blue has an orange.

The color scheme is divided into three general parts, colors in oil, colors in water and colors in dyes. I have here only colors in oil, so it would be impossible with oil colors to imitate either water colors or dyes, but by using red, yellow and blue in oil all color can be made. The same applies to water colors and dyes. For example I cannot take vermilion, which is a sulphate of mercury, and imitate a lake, which is a cochineal dye.

If any gentleman present will name a color, I will endeavor to imitate it and put its harmony with it. All the colors here, about 1,600, are made entirely from these three tubes of paint, except one color, a mauve.

Mr. Johansmeyer.—I will give you a russet.

Mr. Kelly.—A perfect russet is two parts of red, one part of yellow and one of blue, that is if the colors are equal in strength of hue. This red is from four to six times as strong as either the yellow or blue, so I will have to guess at the proportions. This result is a little too red for russet (adds more yellow and blue). This gets a perfect russet. There is no perfect harmony to russet, because it is composed of all three of the primaries. But if used in contrast, take the rainbow color that is farthest from russet or blue.

A member gives brown stone.

Mr. Kelly.—Imitate brown stone with red, blue and black.

Mr. Lorton.—Some years ago a professor of the Cooper Institute delivered a lecture on the harmony of colors.

He had a piano on the platform, and indicated the eight tones of music as similar to the eight colors. I do not know whether you ever saw that.

Mr. Kelly.—Yes, they are analogous; music has hundreds of air vibrations to the second of tune, while color has millions of ether vibrations to the second. The lowest sound we can hear has sixteen vibrations per second, that is equal to a thirty-two foot tone produced by a pipe organ.

Mr. Oliver.—Is it possible to get a steel color?

Mr. Kelly.—I do not think it would be possible to produce it. I do not think it can be done with one coat of paint; it requires varnish to imitate the polish.

Mr. Oliver.—There is a controversy regarding steel color. Certain shades of lead are of the steel color, but there is a peculiar hue about steel color that you don't often see.

Mr. Kelly.—It takes a Prussian blue and white with varnish laid over the lead color to get steel. I never tried to make steel color before, in fact, never thought of it before. I will try and imitate, but do not expect to produce a perfect color. You see it cannot be done by one coat.

Mr. Upham here called for the complementary to orange.

Mr. Kelly.—In a moment; this we will call a tint of orange, and you want the complementary, which is blue.

Mr. Upham.—That is a contrast.

Mr. Kelly.—A contrast is a complementary; it is the same thing. The colors are complementary to each other in contrasting harmony.

MAN'S UPWARD STRUGGLE.

A RESUME OF THE ANATOMICAL PROOFS OF OUR FORMER QUADRUPEDAL CHARACTER.

By Dr. EUGENE MURRAY AARON.

THOUGH still one of the least mature of the sciences, "one of the younger daughters of human knowledge," as it has well been termed, anthropology is already divided into four branches of inquiry, having very diverse fields of action and calling for study from those whose special trainings differ widely. These are, archæology, mythology, philology, and comparative anatomy. These have been the offspring of the parent science for varying periods, having their origin in the order here given. The first three, depending upon external records, have, quite naturally, been given preference in time past; they have attracted to themselves many more investigators, by reason of both the much greater ease of obtaining the material upon which they are based and because of the fact that they call for far less special training than does the last named, though this is less true of philology than the others. While the very essential work that falls to these three cannot be overlooked—the work of archæology, with its entrancing studies of the relics of long forgotten races; the research of mythology, with its fascinating inquiries into comparative religions and the dawn of philosophies; and the delving of philology, whereby we are brought into touch with the early struggle of man to be understood by his fellows—while these may and will not be overlooked, still to the less attractive branch of research which comes within the pale of anatomy, with its comparisons of bone and sinew, muscle and nerve fiber, as they exist in man today, and as they existed in his ancestors, near and remote, must be accorded a very prominent part in solving the problems which are yet stumbling blocks in the progress of the science. For by its aid we are able to read with an ever-increasing degree of exactitude Nature's sign manual, whereby she has left an indelible record of the upward struggle from *monera* to man. Not content with supplying us with a record of man's advance from early prehistoric times, as are its sister sciences, by this department of inquiry we are taken back to a period long before he became

> "A creature who not prone
> And brute as other creatures, but endued
> With sanctity of reason, might erect
> His stature, and upright with front serene
> Govern the rest, self-knowing."*

Among the many interesting problems encountered by the searcher after facts in this field of inquiry none appear to be more pregnant with suggestion than those which have to do with what might be termed man's struggle toward the upright posture. In that battle he has not always been entirely the victor; even yet he is not completely master of the situation, and he carries many scars which speak plainly of a constant warfare between an aspiring mind and a groveling body. A few of the more striking of these signs I wish to briefly discuss here, bringing together into one compass some facts based on researches that are to be found scattered throughout the vast and rapidly growing literature of the medical and kindred sciences.

The effects of the laws governing the transmission of individual adaptations from parent to offspring are now familiar to us, though the actions of those laws are as yet most imperfectly understood. One of the best known results of these laws is that certain influences long acting in a uniform manner on many successive generations become cumulative, and marked permanent differentiation in structure is the outcome. But, as is well known, Nature is never content with her work; the adaptations of seemingly the greatest value to-day are the disused quantities to-morrow. Such, so soon as they are relegated to the realm of the *inutile*, become aborted or atrophied and their place is taken by structures of greater value to the human organism. Yet this period of atrophy is most gradual in its progress; this regression covers a time not only many generations in duration, but in many instances it has, as we have good reason to believe, its origin in an era far antedating that epoch when man first became a factor in creation. It is from these atrophied parts, these vestigial parts of the human animal, that we glean a history of the struggle along that "pathway by which humanity has climbed from darkness to light, from bestiality to civilization—relics of countless ages of struggle, often fierce, bloody, and pitiless."† All are familiar with the old illustration of this principle, that of the blacksmith who, famed for the great prowess of his good right arm, having been prevailed upon to allow it to be tied in one position across his breast and there kept for a period of three months, at the expiration of that time found himself unable to remove it from its long accustomed place when released. The corresponding waste of muscular tissue whereby the trained athlete of the summer time soon relapses into the soft and flabby clerk or student of the winter, if blood supply and use be not maintained, also illustrates how rapid are the first effects of this sort of waste. This applies as well to bone and cartilage as it does to muscular tissue; a high quality of such tissue will soon be replaced with that of an inferior sort, though much more easily maintained on account of its less metabolic nature, *i. e.*, its greater freedom from a tendency toward rapid change, calling for continual upbuilding.

Long continued research, given its initial impulse by Lamarck early in this century, shows that the cells composing living tissue are undergoing continual change, "each impulse from without being registered by some small alteration in their physical condition." [Baker.] Even structures of the most permanent sort are thus modified in time; muscular tension or pull thus in time alters the form of bony structure quite as markedly as wear shapes the enamel-covered teeth or undue weight or pressure curves the spine. All of these qualities have aided in the recording of the successive steps whereby the erect position has been very gradually acquired by man. They speak quite as plainly of the comparatively recent acquirement of this ability as do the efforts in this direction which lead finally to that power in the creeping child. The young chick comes forth firm of limb and steady of gait; the human infant is but little better than a helpless grub. Parallel to this separation in vertebrates is that in the widely differentiated orders—*Hymenoptera* and *Othoptera*—in the *Arthropoda*, wherein the young of the bee is a helpless, soft grub, incapable of locomotion and requiring to be fed by his adult sisters; while the young grasshopper emerges from the egg in form closely allied to the parent and self-reliant and aggressive. In both man and bee we recognize the late acquirement of self-reliance and the full powers of locomotion as indicative of a higher final status in the animal scale and as pointing to the fact that these powers have for long been of less value and lower rank in preceding generations. Naturally, if this be the fact, we shall have no trouble in finding unmistakable indication of it within the human structure. And this we find upon a very cursory examination is the case. Thus we will at once discover that the human vascular system, like that of our four-footed distant relatives, is best adapted for quadrupedal locomotion. This is well illustrated by the difficulty which is experienced by the hunter in seriously wounding a bear. Let the animal remain on all fours, and it is hardly possible to wound a vessel of any size, whereas if he assume the erect position he will, as is the case with man, leave exposed a number of most vulnerable points but a short distance under the surface. For a clearer understanding of these facts, however, it will be well to take a view of some of the most remarkable of them in anatomical order, beginning with the head.

One of the most unmistakable signs of the change from the quadruped to the biped to be found in our system is in the relics still existing in us of the *ligamentum nuchæ*, the extensive, powerful, elastic strap which passes from the occipital region of the head to the thoracic vertebræ and sends filamentous processes to the neck vertebræ. This system of ligaments is required in the quadruped to bear the weight of the head and relieve the spine of undue strain. The equipoise of the head in humans and in the anthropoid apes is such that this is no longer of much value in the erect position, yet unmistakable "ruins" of this vast structure, in the shape of fascial bands, are yet to be easily found in the neck, though, naturally, they are much more atrophied in man than in the gorilla and his congeners. The marked changes in the facial angles from the ultra-prognathism of the orang-outang to that of civilized man are also mainly attributable to the assumption of the permanently upright position. As the weight of the head with its growing cranial capacity increased, the lower jaw has been forced under it and nearer the spine, to aid in maintaining a better balance, and thus has resulted that decrease in the size of the under jaw which is the main characteristic of the civilized countenance. So, while in one case we find that primitive man, nearer the four-footed brute in his organization, possesses in his head an effective apparatus for strife—jaws, teeth, and the powerful muscles for using them—on the other hand the *fin de siecle* product of civilization is possessed of a cranium structurally subordinated to the needs of a creature to whom the possession of an untrammeled brain is the primary requisite. A very interesting study of this subject has been made by Dr. Harrison Allen.*

This change in cranial balance has produced some marked differences. Important among these may be mentioned the crowding of the last molar or "wisdom tooth" back against the ascending curve of the jaw in such a way that its "cutting" has become a useless reminder of the period when that tooth was of value and not so evanescent as at present. In fact it is now no uncommon thing in the experience of dentists to find patients who have never cut these teeth. There is a very evident intention now manifest on Nature's part to eliminate them from our system. Some of our Australasian cousins show an occasional fourth molar or second wisdom tooth, and there is evidence that an incisor has disappeared from the upper jaw in man. The reappearance of the enlarged canines or "dog teeth" in low-type heads is not uncommon, and the muscle that lifts the upper lip from these and bares it for use, which is so prominent in certain *carnivores*, frequently reappears. It is this muscle, as pointed out by Darwin in his *Descent of Man*, that produces the dog-like snarling and the disdainful expressions in which some men excel. It will readily be appreciated that the sense of smell cannot be nearly so necessary to a biped as to a quadruped, especially as while attaining the erect position he has also acquired the ability to cook his food and otherwise so prepare it for

* Paradise Lost, VII., 508-510.

† *The Ascent of Man.* By Dr. Frank Baker. *Proc. Amer. Assoc. Adv. Sci.* Vol. 39, p. 351. Reprinted in *Smithsonian Report*, 1890, p. 447. [This is a most readable and suggestive article.]

* A Clinical Study of the Skull. Smithsonian Misc. Coll., 708, Washington, 1890.

safe consumption that smell is not so constantly brought into play as a means of guarding against the introduction of unsafe food into the stomach. Consequently we are prepared to find olfactory bulbs in the fœtal brain that indicate a recent degeneration of that sense, and that the lower races as well as the manlike apes are better provided in that respect than are we. The third eyelid, common to birds and lizards and useful to them in preventing the entrance of foreign substances into that organ, exists in a very rudimentary condition in man. Around the human ear are yet vestiges of a muscular system only adapted to wagging or moving it; occasionally a person will be found who will exhibit this power in a modified degree with much pride. Its derivation from ancestors so far down the mammalian scale should rob this rare accomplishment of its assumed credit. There now resides a lady in Philadelphia, a member of some of its learned societies, who in addition to this power over her ears has the semi-simian, pointed ears described and figured by Darwin and has cut and retained an unusually large and perfect set of third molars; physically she is thus seen to be a partial reversion to an earlier type, though intellectually she belongs to the advanced ranks of her sex.

As might be supposed, the spinal column exhibits the signs of remarkable modifications adapting it to the erect position. Prior to the fifth uterine month the spine of the fœtus is found to be in a wide dorsal curve suited for the accommodation of the viscera, as is the case in the quadrupeds. Naturally such a curve would make the weight supporting incident to the erect position quite impossible; therefore this main curve is counteracted by two that are so placed as to regain the erect equipoise. One of these is in the neck, so placed as to facilitate the balancing of the head; the other is in the region of the loins and aids in the maintenance of the center of gravity in the proper position. This transformation has been a most gradual one; some of the lower races of men have the spine approximating that of the gorilla and orang, no abrupt line of demarkation existing between them; and in some the backbone is much better fitted for running through tropical jungle and hammock land than for walking perfectly erect in the open.

The theory, now generally accepted by anatomists, that vertebrate animals are compound organisms "formed by the union of a series of disk-like segments arranged on a longitudinal axis," indicates their ascent from some form closely allied to the annelid worms, in which a single segment produces by continued budding, or self-reproduction, a complex body. This theory is fully warranted by a careful study of the human embryo, the uterine life of which exhibits a series of just such transformations as such ascent would call for. Without taking the skull into consideration there are in the human adult thirty-three or thirty-four vertebræ that are the representatives of this segmentation; while such segmentation was doubtless originally uniform in character, continued change in duties to be performed, and in the environing muscular and vascular systems, working both directly and through a long line of inheritance, has resulted in a marvelous system of modifications from which are derived such widely differentiated segments as those of the neck and those of the thorax, with their attached processes, the ribs. In the adult thirty-three post-caput vertebræ are the rule, while at one period in the life of the fœtus thirty-eight may be counted. The extra segments are not always wanting in the adult, however; but when present they are always to be found in the caudal series, where they form the continuation of the bony structure of the rudimentary tail which is yet present in all skeletons. Lissner has given a careful description of a girl of twelve in whom this surplus segmentation, being covered with flesh, formed a well defined tail 12·5 centimeters (nearly five inches) long. Dr. Max Bartels, of Vienna, has collected from the widely diffused medical and scientific literature reports of 116 actually observed cases of tailed men. Some of these refer to whole tribes; they are from all parts of the globe and cover the period of the last one thousand years. Some of these record instances where these appendages were of much greater length than that described by Lissner. It is quite plain that the erect position, causing a constant rubbing of the basal vertebræ of this appendage between the *glutei* (buttocks), and the consequent increase in the use of the sitting posture likely to be a result of upright walking, would in time account for the disappearance of the tail in man, though its now rudimentary root and its occasional reappearance in a somewhat atrophied state seem to be sufficient to rob us of any lordly feelings that we may be inclined to indulge in when viewing our distant relatives the tailed monkeys. Nor are these all that we can find in this region that are calculated to humble us in this way. The *ischio-coccygeus* and the *sacro-coccygei*, muscles for flexing, extending and laterally moving the tail, still are to be found in a vestigial state. So, too, we may discover in ourselves, at that point where, if present, the tail would appear, a dimple often surrounded by a faint whorl of hairs, both of which are indicative of the regressive growth that has taken place.

In the thoracic and visceral regions much is to be found that is indicative of this upward struggle; here it is that we find the least perfect adaptation to the present posture. Nature still clinging to structural forms that, while well adapted to quadrupedal locomotion, are a positive menace to the upright animal. Among these the most prominent is that of the *cæcum*, with its *appendicula vermiformis*, well termed a "death trap." This has long ceased to be of functional value to man; far down the line of his vertebrate ancestors must we look to find it in a state of useful activity. Yet in the four-foot higher animals it is so positioned that gravity frees it from fæcal accumulations which in man, on account of his erect position, find a lodgment therein, causing inflammation. So serious is this, that cases where a grape seed or like object has found this trap a good lodging place, and death has been the consequence, are by no means rare. The position of the urinary bladder is another almost equally naked illustration of the disadvantage under which man still labors in the erect position. In the lower mammals the urethra is so situated, by virtue of their horizontal position, that it perfectly drains the bladder, while in man, as pointed out by Dr. Erasmus Darwin so long ago as 1805, "the fundus of the bladder in an erect posture is not exactly over the insertion of the urethra; whence it is seldom completely evacuated, and thus renders mankind more subject to the stone than if he had preserved his horizontality."* So, too, is it with the positions of the great venous trunks and some of their valves. The horizontal position is favorable to the regular and safe flow of the blood. Some of the valves are so placed while man is erect that they are entirely useless; but let him assume the horizontal position, and it will be observed that they and the entire system to which they belong are so placed as to be operated by the action of gravity. Clevenger has demonstrated that to these valvular inequalities in the biped are to be attributed such troubles as hemorrhoids, varicose veins, etc.

There are two classes of derangement that are caused by the mechanical defect of having the main trunks in a vertical position. First, those that are caused by the difficulty of pumping the blood up through the *vena cava*, from which arises congestion of the liver, dropsy of the heart and other like disorders; secondly, such as are caused by the too rapid flow through the descending *cava*, from whence comes syncope or fainting.

Perhaps the most striking proof of this struggle between horizontal fitness and vertical desire is to be found in the female pelvis of the human. In quadrupeds the visceral load is carried in a sling, a suspensory bandage known as the *tunica abdominalis*, fastened to the horizontal spine. This has entirely disappeared in the upper regions but yet remains to aid in supporting the lower weights in man. Still, however, most of this now bears on the pelvis, which in man has become a dish-shaped structure. But it is through this bony, non-elastic support that parturition must take place; consequently two vitally important objects must be provided for. That rupture may be rendered as infrequent as possible it is desirable that the pelvic orifice should be narrowed to the last degree; that child-birth may be facilitated it is necessary to have an ample aperture at this point. Now, as we have seen, the increase in the size of the upper cranial region has been a coincident movement with that of the assumption of the erect position, and as this position has imperatively called for a narrowing of the pelvic orifice, it is not at all remarkable that delivery has come to be a most serious affair with many women in civilization, and bids fair to be a problem of ever-increasing gravity so far as we can now discern. Uterine displacements, so common among civilized women, are almost unknown among quadrupeds; and, as pointed out by Baker, it is significant that one of the most effective postures for treating these complaints is that known as the "knee-elbow position," which is thoroughly quadrupedal in character.

In the limbs the presence of the bands of the cervical fascia are vestiges of the time when the horizontal was our normal posture. These in the lower mammals are used to pull forward the shoulder girdle. Baker remarks their greater prevalence in a nearly unatrophied condition in some negroes. So, too, the remarkable formation of joints whereby the erect position is maintained by the legs without the wear and strain that would be the consequence was all of this work relegated to the muscular system, being much more complete in civilized man than in his primitive brothers and far more so than in his anthropoid cousins, speaks of a recent adaptation in the ascending scale.

The differentiation existing between the hand of man and the higher apes is too well known to call for other than passing mention. The human hand is a rich field wherein to search for vestiges of the change that has taken place in an organ that but a brief period back was used nearly equally with the feet for support, but which now is a purely prehensile appendage. Their greater adaptation to the work recently assigned them has led to a coincident abortion of this power in the human foot, a power that is possessed in no mean degree by the monkey tribe. However, cases are not infrequent where this power is retained by man. Armless wonders there have been to whom writing, eating and even very creditable painting have been possible, so expert have they become with their semi-prehensile toes. I have myself sailed in West Indian waters with a black skipper who managed the tiller with one hand, a sail sheet with the other, and still another sail with the rope passed between the big and first toes of his right foot. I could not discover that his grip was any less efficient in the foot than in the hand. A recent article on the "Decline and fall of the little toe,"† will be found interesting reading in this connection.

The foregoing is but a hasty presentation of a few of the most marked facts which point unmistakably to the struggle that man has had and is, in a lesser degree, still having to maintain his erect position. Much more of a more intricate nature is known; but there can be no doubt all that is yet known is but a small fraction of what remains to be discovered. The whole subject of the effects of use and disuse in the parent upon its progeny is an open and yet debatable question.‡ But before many of these yet unascertained facts can be ours we must have a more intimate knowledge of the structure of primitive races. This must not be derived from generalizations based on the study of comparatively few isolated cases drawn from exhumed remains and from savage peoples, but must be based on large and varied series from all sources. I cannot do better in closing this *resume* than to quote the words of Mr. John Evans, F.R.S., when alluding to the pressing need that anthropology now has of immediate aid in the direction of obtaining more extended acquaintance with the yet savage or semi-civilized races. "I have made this incidental mention of this subject," he says, "rather from a feeling that in Africa, as well as in Asia and America, native races are in danger of losing their primitive characteristics, if not of partial or total extermination, and that there the anthropologist and naturalist must take the earliest possible opportunities for their researches."§

* *Temple of Nature*, Canto II., foot note to line 122.

† Boston Med. and Surg. Jour., vol. 122, p. 356.

‡ An interesting presentation of this question will be found in *Are the Effects of Use and Disuse Inherited?* By W. P. Ball. New York: Macmillan & Co., 1890.

§ Address before the British Assoc. Adv. Sci. From *Nature*, Sept. 18, 1890; vol. 42, p. 507.

ALTERATIONS OF PERSONALITY.

Les Altérations de la Personnalité. Par Alfred Binet. Bibliothèque Scientifique Internationale. (Paris: Ancienne Librairie Germer Baillière et Cie., 1892.)

IN what is in ordinary parlance called somnambulism, or sleep walking, the patient rises in the night, performs a number of seemingly intelligent actions directed to some special end, answers questions with regard to such actions with a variable amount of coherence, returns to bed, and generally, but not in all cases, wakes in the morning with no remembrance of that which he has done during the night. Such is somnambulism in its narrower sense. It exhibits the individual in an abnormal psychological condition, the actions performed in this abnormal condition being generally unconnected in memory with the normal sequence of events in waking life. The word somnambulism is, however, now used in a wider and at the same time more technical sense, being applied to all cases where the individual, either spontaneously or through hypnotic suggestion, falls into an abnormal condition distinguishable from the normal condition of his or her waking life. It is with the alterations of personality exhibited during the state of somnambulism in this wider sense that M. Binet's volume chiefly deals. The subject is one that is beset with peculiar difficulties, and one in which extreme caution is necessary in drawing anything like definite conclusions. But it is one that is throwing, and is likely to throw, important side light on normal psychology, and one that may prove helpful in elucidating the difficult problem of the nature of the association of brain and consciousness. It will only be possible in the space at our disposal to indicate the nature of some of the evidence M. Binet adduces, and the interpretation suggested by this learned and lucid writer.

The phenomena of so-called spontaneous somnambulism are somewhat as follows. The patient is, we will say, a dull and melancholy young woman. She falls into a deep and prolonged sleep, or suffers from an hysterical or convulsive crisis. On waking from the sleep, or emerging from the crisis, she is in an altered condition, with little or no memory of her previous life, and no apparent knowledge of her friends and relations. Her character is changed: no longer dull and melancholy, she is bright and merry. In this state she remains for a time, learning anew the ways of the world, and daily profiting by her fresh experiences. Then she falls again into deep slumber, or other crisis, from which she emerges her old self once more, taking up her normal dull and melancholy life just where she left it. She remembers nothing that happened in her abnormal or second state. There is no continuity between the two. Such alterations of personality may continue at varying intervals for many years.

Somewhat similar are the phenomena observed in the somnambulism induced through hypnotic suggestion. M. Janet's subject, Leonie, is a serious and rather sad person, calm and slow, very mild with every one, and extremely timid. Hypnotized, she becomes a different being. She keeps her eyes closed, but her other senses are abnormally acute. She is gay, noisy, and restless; good natured, but with a tendency to irony and sharp jesting. In this condition she repudiates her former self. "That good woman is not myself," she says, "she is too stupid!"

M. Binet, summarizing the principal modifications of memory in hypnotic somnambulism, says that the subject, during the normal condition, remembers nothing of the events which have taken place during somnambulism, but that when hypnotized he may remember not only the occurrences in former somnambulisms, but also those which belong to the normal state. There is thus some continuity of the normal into the hypnotic personality, but none from the hypnotic to the normal. "Le livre de la vie somnambulique se ferme au réveil, et lay personne normale ne peut pas le lire."

But though there is no conscious memory in the waking state of what has occurred during somnambulism, it is said to be possible to unseal the register thereof through automatic writing. A fact is told to the subject in the state of somnambulism under hypnosis, and the subject is then restored to the normal state. He has no recollection of the fact, and knows nothing about it. But slip a pencil between his fingers, hiding the hand from his eyes by means of a screen, and he will write down the fact automatically. (Gurney.)

In cases of so-called "negative hallucination" or "systematic anæsthesia," the subject under hypnotic suggestion neglects and is apparently blind to certain objects. For example, two out of a number of blank cards are marked with a cross, and the subject is made blind to these. If she be given a dozen cards, and among them these two, and if she be asked to count the cards, she will neglect these two and reply that there are ten. But if a pencil be slipped between her fingers, and she be asked in a low voice how many cards there are, she will reply, in automatic writing, *two*. And if she be asked, in the same tone, why she said ten and neglected these two, she will write in reply that "she could not see them."

On the basis of such observations as are here briefly summarized, and others for a description of which we must refer our readers to the book itself, M. Binet contends that, associated with the same physical individual, there may be two (or more) personalities, both of which are conscious. They may be co-existent or successive. Anæsthesia is the barrier which separates co-existent personalities; amnesia the barrier which separates successive personalities. "En un mot, il peut y avoir chez un meme individu, pluralité de mémoires, pluralité de consciences, pluralité de personnalités; et chacune de ces mémoires, de ces consciences, de ces personnalités ne connait que ce qui se passe sur son territoire." We do not propose to discuss this position. Suffice it to say, that for ourselves we see no satisfactory evidence of the *co-existence* of two personalities *both of which are simultaneously conscious.* Strange alterations and modifications of personality may occur under peculiar circumstances; but this is something very different from the supposed coexistence of two or more distinct consciousnesses.—*C. Ll. M., in Nature.*

RECENT experiments by German physicians indicate that cancer is contagious.

THE HORSE WORLD OF LONDON.

By W. J. GORDON.

THERE is no more eloquent testimony to the orderliness of London than the mere sprinkling of cavalry within its limits. It may seem ridiculous to the foreigner that with 375 mounted police and two small regiments of Household troops numbering 275 horses each, five millions of people are content to behave themselves; but it is a state of affairs of which Englishmen have no cause to be ashamed. Even adding in the six battalions of Foot Guards and the line battalion at the Tower, and considering that there is Woolwich, and that there are Hounslow and Windsor not far off, and that there are facilities of communication—not, however, greater than exist in other capitals—we shall find that the police and military ready to be used as police, in and about London, are a mere handful compared to what are necessary for peace-keeping and ceremonial purposes in the cities across the channel. And the display made of these is proportionately much less, for, as a matter of fact, the ordinary Londoner is aware of the presence of cavalry by reason only of the two specimens on view daily in Whitehall.

At one time the black horses of the Household cavalry came almost entirely from Yorkshire and North Lincolnshire, most of them being expressly bred for the service. But of late we have changed all that. In those days the cavalry colonels had so much money allowed them for remounts, and they had to pick up their horses where they could, with the jobmaster at their elbow—for a consideration—to help them at a pinch; and some of the London jobmasters had a standing order to be on the lookout for likely horses for certain regiments. Nowadays the Dublin dealer has taken the place of the London man, and, instead of the colonel buying horses, the buying is done by the Remount Department, whose happy hunting ground is Ireland.

When a military horse is "cast," and all military horses are "cast" at 14 years old, whether they be good, bad or indifferent, a requisition for a substitute goes to the Remount Department at Woolwich, and the substitute arrives a day or two afterward from the Emerald Isle, generally shipped direct by Daly or some other Dublin dealer. That the new horse is as good to look at as the old Yorkshire one, we have not heard any soldier declare, but he is at least 30 per cent. cheaper, and he seems to be strong enough for his work.

A British army corps, when discoverable, will be found to have 12,000 horses, of which 3,134 will be in the cavalry and 2,987 in the artillery; these 6,121 horses ought to be thoroughly broken and trained, even if the remainder are not. There are said to be only 70,000 horses in the British Isles fit for army work, but this is one of those pleasant fictions of which it is left to the foreigner to discover the fallacy. Like a good many other statements regarding our preparedness for self-defense, it is to be taken plus x, x representing the dominant number.

When Napoleon attempted to invade us—an attempt that was defeated at Trafalgar, which to the uninitiated may seem to be a long way off for the defeat of such a scheme, although any future attempt will probably have to be reckoned with still further at sea—the government took stock of every horse in the kingdom, with the intention of a general impressment for military service; and nowadays the government has power in times of national peril to lay hands on every horse within these islands, in preparation for which there are thousands of horses under subsidy with a view to immediate use. And when this seizure does take place, it will certainly not be to the joy of the jobmaster; he above all men shudders at the mere mention of foreign invasion, for invasion to him means the entire loss of his means of livelihood, and this at a sacrifice, for no government would pay the price at which the jobmaster's stud has been collected.

The Life Guardsman's horse used to cost £60, being the most expensive horse in the army; we shall not put him offensively cheap in these times at £20 less; nor shall we be divulging any secrets of state in estimating the cost of mounting the two regiments of cavalry in London—barring the officers' chargers—does not exceed £22,000.

And yet the horses are carefully chosen and seem fit for their work, when either in or out of harness. They of course look their best at Knightsbridge, for at Knightsbridge the stabling is distinctly good, better even than is promised in the new barracks in Albany Street; but then a soldier's horse in stable generally looks better than a civilian's, owing to his head being where his tail should be. The civilian's horse always has his head over the manger; the soldier's horse is turned round as soon as he has finished his feed, and so gets more fresh air; the consequence of which admirable arrangement for preventing a horse "breathing his own breath" is that the visitor on entering the stable sees a double line of intelligent heads, instead of an avenue of hocks and tails.

Time was when every soldier's horse had a name, the initial of which was that of the troop to which he belonged. "A" troop had all A's, "B" had all B's, and so on; but in these days the squadron is the unit, not the troop, and the name has given place to the number. Every horse, then, has his number placed on a card over his manger, and the horses are separated from each other by a pole doing duty as a bale, and on each upright is the horse's kit, including the two spare shoes which every trooper carries, but not including the arms; which, of course, are kept elsewhere. This kit, and the arms and the rider, make up a nice little load, which averages out at twenty-three stone per man; not quite so heavy as that of our fat old knights, but still heavy enough for the class of horse which has nothing of the "dray" type about it.

It is not so easy to get these horses of uniform type and character. There are many exchanges and rejections, and it often happens that a horse sent in for cavalry work has to go to the draught, to the artillery, or even the transport service; so that though the remainder may not be examples of the much talked of survival of the fittest, they are at least representative of the not unfit. They are smart, workmanlike horses. It is absolutely necessary that a regiment should be as sound in its horseflesh as in its men. Theoretically, no remounts are accepted that are not looked over on level ground, on a road, or in a large yard, for it is easy to pass a bad horse in a field, or on a hillside, or in deep pasture, or when under cover, or in a drove. It is not safe to choose an underbred animal, immediately conspicuous by his coarse head, or thick throat, or short neck, or large, bony joints, or clumsy legs, or short pasterns, or curly in the hair of his mane or tail. The typical cavalry horse must have a small, lean head, a flat, broad forehead, fine, full nostrils, a good, clean throat, thin neck, well shaped legs, long pasterns, and straight hair, with a deep, wide chest, and a short, broad back and loin. No long backs will do, for long backs do not carry weight, and short necks or croups are simply impossible for soldiering. Of course the horse has to be of the regimental color. In the cavalry generally chestnuts are not in favor, for chestnuts usually have white, and white, except in the Scots Greys, is not desirable; neither chestnuts then, nor mealy bays, are fit for cavalry work, but roans and bays and browns, and, for our guardsmen, blacks.

These are bought when rising four years old, and require about six months training by the rough riders before they can be passed out of the riding school as efficient by the colonel. The Knightsbridge riding school is about forty-five yards long by sixteen wide, and in it perhaps fourteen young horses at a time will be at work, though the number of course depends on what the horses have to do. Their training is not as simple as might at first appear. The soldier has only one hand to work his horse with, and what an ordinary rider would do with the other hand he has to do with his leg. How skillfully he manages to guide by leg pressure is known to those who have seen the Musical Ride at the annual Military Tournament, which is little more than the ordinary practice of the riding school. But it should not be forgotten that the horse has to be taught to understand this pressure, and that his training is almost as long a business as that of his rider.

Very early in the morning, so as not to alarm the passers-by, the young horse is taught to stand fire by having a gun discharged close to him, and being encouraged to smell the powder and the smoking weapon; he thus becomes familiar with the sound and scent, much as a boy does, though there is nothing to show that he ever associates the idea of being shot with the report which he soon treats with indifference. When once he is trained his work becomes lighter, and he cannot be said to have a hard life in London, an occasional outing at Wimbledon being his severest trial. Being condemned at fourteen, his full service is a little over ten years; but it is rare that he reaches the limit, and his average military life is between six and seven. When it is over he goes back to the depot, and thence he often comes again by way of the sale yard into the London crowd.

The number of horses in London used exclusively for riding is very small. Taking them altogether, and including the police and military with the rest of the community, we shall not have one per cent. of the general herd. A good many of these are introduced direct from the dealers, but a large number are knocked in, and down, at Tattersall's.

Tattersall's is usually looked upon as the headquarters of horsey London. It is certainly the headquarters of the horse of pleasure, but, as has been made clear in these pages, that sort of horse is simply lost in the thousands that throng our streets. Tattersall's is practically the great betting exchange, but the visitor to any of the Monday or Thursday sales will be puzzled to find the least sign of a betting atmosphere at Knightsbridge. The two things are as distinct on those days as, say, the Bank of England and Capel Court. The yard is under cover, a lofty glass-roofed hall, which cost £30,000 to build, and which is as big as many a railway station. It is surrounded by a handsome gallery, behind the arched and columned screen of which every type of pleasure vehicle seems to be "on view," duly numbered in "lots" for the hammer. In the center of the gravel area is a drinking fountain, surmounted by the quaint old Georgian bust of the founder, with its eyes fixed on the entrance doors, and its thoughts apparently as far away from water as are those of the crowd around.

It is a different variety of crowd from that which gathers in any other sale yard. London has several "repositories." There is Aldridge's in St. Martin's Lane, there is Rymill's in the Barbican—these two being the chief; and there are Stapleton's out in the east, and Ward's in the west, and the Elephant and Castle in the south, and others which many a horse knows well. There is a sort of horse that "knows the lot;" the sort that "does the round," and brings more money to the auctioneers than to the unfortunate buyers, who "find him out" in a fortnight, and "get rid of him sharp" to an unwary successor; a wonderful animal this horse, "quiet in harness, a good worker," who has only two faults, one that "it takes a long time to catch him in a field," the other that "he is not worth a rap when caught." But this kind of a horse does not put in many appearances at Knightsbridge. Tattersall's has a character to keep up, and it has kept it up for 126 years now. It is eminently respectable, from the unused drinking fountain and the auctioneer's hammer, one of the good old pattern, with a rounded knob instead of a double head, down to the humblest hanger-on.

Entering one of the stables which open on to the yards, and have a dozen or more roomy stalls apiece, we find a horse being measured, to make sure he is correctly described. One would think that he was a recruit, from the careful way in which the long wooden arm is brought down so gingerly as not even to press in his skin. Soon his turn will come. Up in the gallery will go his number, and the young auctioneer in the rostrum below—which has a sounding board as if it were a cathedral pulpit—will read out his short title.

Out comes the horse at last—tittuppy-trot, tittuppy-trot. "Ten," says one of the crowd. "Ten guineas," echoes the auctioneer. "Twelve," comes from the crowd; "twelve guineas," echoes the 'Varsity man in the pulpit. And so the game goes on with nods and shouts, each nod or look being worth a guinea, so that the solo runs, "Thirteen—thirteen guineas—fourteen guineas—fifteen guineas—sixteen—sixteen guineas—seventeen—eighteen—twenty guineas"—quite a sing-song up to—"twenty-eight guineas"—and so gradually slowing, with a spurt or two to "forty guineas"—and then a grand noisy rally till "fifty-five" is reached. "Fifty-five?—Fifty-five?—Fifty-five? Last time, Fifty-five!"—knock—and away goes Captain Carbine's hunter, to make room for a "match pair" that will change hands at 165 guineas, or perhaps fifty more if the season has begun—the bidding always in guineas in order that the auctioneer may live on the shillings, as Sir John Gilbert used to do in the old days when the guineas flowed to him for his drawings on the wood.

LIFE GUARDS.

If you want riding horses or carriage horses, you go to Tattersall's; if you want draught horses for trade, you go to Rymill's or Aldridge's, where you not only get the new-comers, but also the second-hand, and many-another-hand, from London's stables. With those second-hand horses we need not overburden ourselves; our task has been to bring the first-hand horses into London, and sort them out. We have brought in the 'bus horses, the tram horses, the cab horses, the railway horses, the cart and many other horses. Of the cart horses we could, if it were worth while, say a good deal more. We have said nothing of the distiller's, the miller's, the soap merchant's, the timber merchant's, the better class contractor's, and half a dozen other first-hand horse-owning trades. Some of the distillers' horses are said, by those who know, to be as good as any in the brewers' drays, and by "as good" is meant that they are of the same breeding, and can be compared with them, owing to their being at somewhat similar work.

The man who says he knows everything about horses—and he is rather a common object of the street—seems to compare all horses he sees with a thoroughbred racer, and knocks them off as beauties or beasts in the terms of that comparison. He forgets, or does not know, that there are other stud books than those that come from Weatherby's, and that the different breeds of horse are made and kept alive for their fitness for different occupations; and he also forgets, or never knew, that there is no man living competent to judge all down the lines that lead and mingle from the pedigree stallions of the Racing, Cleveland, Clydesdale, Shire, Suffolk, Pony, Hackney, and other stud books.

As regards what we may call the "medium" brigade, the lighter cart horses, or vanners, of no particular class or pedigree, the opinion of the man in the street, though valueless, is not unreasonable. They are, it must be confessed, a curiously miscellaneous lot, most of them not doing half enough work for their weight, owing to their power being at the wrong end. They come early on the scene, some of them at four years old, and they linger late. For the first year or two they fetch from forty to sixty guineas, seldom more, and they sort themselves out rapidly into the twenty pound line, owing to their being unequal to the work that is put behind them. "Call that a horse!" we heard re-

cently from the depths of the crowd in the Poultry. "Why, he has got no power astern; he climbs along!" And that is exactly the state of the case with hundreds of the London vanners. But then such horses are possible because they are cheap, and we must not expect too much of them. Their life is a hard one. As a rule, they are worked long and wearily; but, unlike "that useful horse, the hackney," they have a Sunday's rest.

The hackney is too useful a horse for his own good. Six days a week he works to earn money, and on the seventh he works to spend it. And so the hackney is soon knocked up, and changes hands oftener than any horse in London. Yet one more class of first-handers, and that is the ponies, which keep to their first owners longer, and, in the ownership of sweeps, attain frequently quite a remarkable healthy old age. And with the first-hand ponies and hackneys our herd reaches the 150,000, and we confirm the usual estimate that half the London horses are at least second hand.

Three hundred thousand horses! Not a tenth of what there are in this island; but what a herd it seems! And what are they worth? Taking them at £25 apiece they would run to £7,500,000, and that, as we have seen, would be putting them at a low price. To keep them at less than half a sovereign a week we should require seven and a half millions a year; and if we add to this current cost the interest on the capital sunk in them, and their harness, the wages paid in looking after them, and the rent of their stables, we shall get into figures that seem almost too large to be true.

The London horses rarely die natural deaths. Many of them are sent back into the country in a vain hope that they will "come round;" many of them are poleaxed for very shame at their miserable appearance; some of them slip and injure themselves beyond recovery in the streets.

A dreadful object this of a suffering horse sprawling in one of our main roads with the usual crowd around it. "Why cannot he be killed at once? Why must he linger in agony? Surely——" Quite so, gentle reader and indignant letter writer to the daily newspapers, but do not be in a hurry! The driver has no right to order the horse to be killed; it is not his property, but his master's; and before he can give the order the master has to be found, and the master does not, in many cases, care to lose his horse irrevocably, and appeals to his vet.; and so, while the driver is finding his master, and the master is finding his vet., the horse lies suffering in the street. When the needful permission is obtained, a telephone message to Harrison Barber brings the cart on the scene, and within half an hour of that message the horse is not only dead, but being cut up in one of the Harrison Barber depots. There are seven of these depots in strategical positions round and in London, where the carts are kept cleaned and in readiness, tools and all, like fire engines, ready to be turned out and on the way in less than five minutes from the receipt of the call.

A curious trade is that of the horse slaughterer, who must not only have a license, but carry on his operations in accordance with the 26th of George the Third and other acts of Parliament. No horse that enters his yard must come out again alive, or as a horse. The moment it enters those gates it must be disfigured by having its mane cut off so close to the skin as to spoil its value, and though it may be put in a "pound" on the premises, which might better be called a condemned cell or a moribundary, it must not remain there for more than three days.

In Garratt Lane, Wandsworth, is the largest horse slaughtering yard in London. It has existed for about a hundred years. There it stands, practically odoriess, by the banks of the winding Wandle, with a wide meadow in front of it and a fireworks factory next door, the magazine of which is within measurable distance of its boiler house. One fine morning—it was really a beautiful morning—we found our way down the lane, along the field, armed with Mr. Ross's permit, to be initiated by Mr. Milestone into the mysteries of a horse's departure from the London world.

The last scene does not take long. In two seconds a horse is killed; in a little over half an hour his hide is in a heap of dozens, his feet are in another heap, his bones are boiling for oil, his flesh is cooking for cat's meat. Maneless he stands; a shade is put over his eyes; a swing of the ax; and, with just one tremor, he falls heavy and dead on the flags of a spacious kitchen, which has a line of coppers and boilers steaming against two of its walls.

In a few minutes his feet are hooked up to cross beams above, and two men pounce upon him to flay him; for the sooner he is ready, the quicker he cooks. Slash, slash, go the sharp knives, and the hide is peeled off about as easily as a table cloth; and so clean and uninjured is the body that it looks like the muscle model we see in the books, and in the plaster casts at the cornchandler's. Then, with full knowledge gained by almost lifelong practice, for the trade is hereditary, the meat is slit off with razor-like knives, and the bones are left white and clean and yet unscraped, even the neck vertebræ being cleared in a few strokes—one of the quickest things in carving imaginable.

If there is any malformation, the sweep of the knife is stayed for a moment; that is all. The same sort of thing has always been seen before, and there is no hesitation about the way to deal with it. No matter of what breed or age or condition the horse may be, his "boning" is not delayed by peculiarities. And horses of all sorts, some of them sound and in the prime of life, here meet their doom—the favorite horse killed at his master's death, to save him from falling into cruel hands; the runaway horse that has injured a daughter; the brute that has begun to kick and bite; the mildest mannered mare that has perhaps merely taken a wrong turn and made her mistress angry—all come here to die with the hundreds of the injured and the old. Taking them all round, the old and young and sound and ailing, they average out in the men's opinion at rather over eleven years when they here meet their doom.

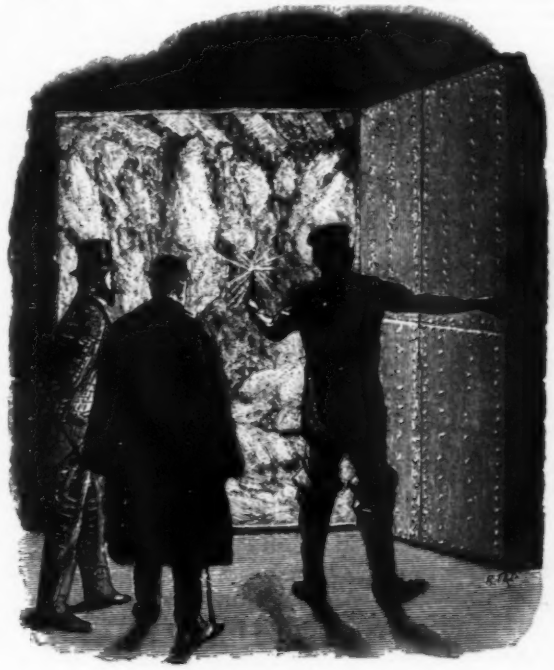
Soon the bare skeleton remains to be broken up, and in baskets go aloft to be shot into a huge digester, where it is made to yield about a quarter hundredweight of oil. Following the oil, we see it cleared of its stearin, pressed out between huge sheets of paper, and remaining in white cakes like gauffres ready for the candle makers; and we see the oil flowing limpid and clear into the tank above, from which it is barreled off to be used eventually for lubricating and leather-dressing purposes.

Returning to the bones, we find them out on the flags, clean and free from grease, ready to be thrown into a mill, from which they emerge like granite from a stonebreaker, down along a sloping cylindrical screen, which sorts the fragments into sizes varying up to half an inch. And stretching away from us are sacks, full to the brim, with bones all in rows, like flour sacks at a miller's, all ready to go off to the manure merchant's. And still further following the bones, we find some of them ground to powder and mixed with sulphuric acid, to leave the premises as another form of fertilizer.

Having seen the bones off the premises, we follow the feet, of which we find a huge pile, not a trace of which will be left before the day is out. The skin and hoofs will go to the glue makers and blue makers; the bones will go to the button makers; the old shoes will go to the farrier's and be used over and over again, welded in the fire and hammered on the streets, so that all that is lost of a horseshoe is what rusts or is rubbed off in powder.

With a glance at the tails and manes, which will soon be lost in sofas, chairs, or fishing lines, we reach the heap of hides, which will probably find its way to Germany to be made into the leather guards on cavalry trousers, or may be stay in this country for carriage roofs and whip lashes. This distribution of the dead horse may seem to be an odoriferous business, but the odors are reduced to a minimum by an elaborate ventilating system which draws off all the fumes and emanations into a line of pipes, and passes them over a wide furnace to be burnt, so that none of them reach the outer air.

But now for the "meat" which, cut into such joints as the trade requires, has been boiling in the coppers and is now done to a turn, with just the central tint of redness and rawness that suits the harmless necessary cat, while the "tripe" is doing white in another copper to suit the palate of the less fastidious dog.



THE KNACKER'S REFRIGERATOR.

Harrison Barber, Limited, the successors of the once great Jack Atcherley, dead some thirty years since, kill 26,000 London horses a year. All night and all day the work goes on, this slaying and flaying, and boning and boiling down, and this cooking for feline food. Go to any of their depots between five and six o'clock in the morning, and you will find a long string of the pony traps and hand carts, barrows and perambulators, used in the wholesale and retail cat's meat trade. The horse on an average yields 2 cwt. 3 qrs. of meat; 26,000 horses a year means 500 a week, which in its turn means 70 tons of meat per week to feed the dogs and cats of London.

This is not all the "meat" that is sold, nor all the London horses that are killed, for the horseflesh trade is large enough to employ thirty wholesale salesmen; taking even this ten tons a day, we shall find it means 134,400 meals, inasmuch as a pound of meat cuts up into half a dozen ha'portbs—the skewers being given in, though it takes half a ton of them to fix up a day's consumption. Here is another item for the forest conservation people! 182½ tons of deal used a year in skewering up the horses made into meat by Harrison Barber!

Sometimes there is a glut of the aged and the maimed, and the supply of meat exceeds the demand. To cope with this difficulty a complete refrigerating plant is at work at Wandsworth, cooling the larders, in which two hundred and fifty horses can be stored; which larders are not only a revelation, but a welcome surprise.

A door is opened and shut, and we stand in the darkness between two doors in an air lock; the inner door is opened, and a shiver of cold runs through us as a match is struck and a candle lighted: and there in front is what looks like a deep cave in an arctic drift. Around us are piles of meat, all hard as stone and glittering with ice crystals; overhead, and at the back of all, the beams and walls are thick with pure clinging snow; and from above a few flakes fall as the door closes on the silvery cloak that wraps the last to leave the horse world of London.—*Leisure Hour.*

AN OBSTACLE TO SCIENTIFIC PROGRESS.

By Dr. G. GORE, F.R.S.

THE recent recovery of Mr. Waterston's paper from the Archives of the Royal Society by Lord Rayleigh, and its publication after having lain there about fifty years (*see Chem. News.*, vol. lv., p. 219), illustrates the less encouragement given in this country to scientific researches containing really original conclusions or phenomena than to any other kinds of such researches.

As scientific researches which are reliable and original are as necessary and valuable as those which consist of accurate measurements without originality, it seems desirable that some arrangement should, if practicable, be made, by means of which such papers as that of Mr. Waterston's (and probably others) would be saved from oblivion, and be, if possible, as competently examined and as fully recognized and published as less original ones. However important a high degree of accuracy of measurement of known phenomena is, the discovery of entirely new phenomena and new truths is essentially more important, for if no new phenomena or truths were discovered, there would be none to be measured. Out of Faraday's simple qualitative discovery of magneoptic action arose Clerk Maxwell's mathematical theory of light.

A great obstacle, however, to the accomplishment of this very desirable object arises from the following circumstances: (1) All new truths require to be expressed in new language; (2) in consequence of the fixity of strongly impressed previous ideas in the brain, new discoveries and conclusions are only fully appreciated by a new generation of men; and (3) as the examiners of scientific researches are frequently teachers of long experience, their ideas are apt to become so fixed by long-continued teaching that, notwithstanding their anxiety to do justice to the authors, they are unable to fully understand the new phraseology and phenomena, and therefore discourage the publication of really original researches. The so-called "conspiracy of silence" of scientific men respecting the reality of new scientific discoveries is simply a result of this fixedness of mental impression; the examiners being men of high ability and integrity hesitate to express opinions of matters which they do not fully and clearly comprehend, and other men of science follow their example and remain silent.

It is largely in consequence of this hindrance, and of the almost universal desire of mankind for some *immediate* advantage, that any and every kind of scientific occupation is more encouraged than fundamental original experiment; accounts of inventions and technical investigations are accepted and published as if they were of greater value than the discoveries upon which they are based, and accurate measurements of known phenomena are treated as if they were of more importance than the discovery of new fundamental truths; and the readiness of acceptance and publication of a new truth is often inversely proportionate to its degree of essential importance.

To make laborious and expensive researches, and have them (and especially the valuable experimental evidence contained in them) practically suppressed and consigned to oblivion simply because they are original and cannot be readily understood, is most discouraging and unjust to investigators, a great obstacle to scientific and national progress, and deserves the serious consideration of those publishing bodies who undertake the acceptance or rejection of scientific papers.

Probably the most effectual method of overcoming the difficulty would be for a committee of paid examiners to actually repeat a sufficient number of experiments, etc., to enable them to arrive at a demonstrable conclusion in each case. This, however, would be an expensive plan, but it would be only a small expense in comparison with that of making the researches themselves, and the importance of the object would justify the cost. The skill and labor required would be too great for unpaid examiners.

The progress of science can never be very satisfactory in this country until this obstacle is removed, nor until scientific men generally treat different problems and truths of science more in accordance with their essential degrees of importance and less according to their

extrinsic or *immediate* practical value. Nor will science itself be treated with the highest respect while scientific men in general pursue money and trading in knowledge so much more earnestly than knowledge itself. We are all apt to be blinded by the prospect of immediate personal gain, and fail to perceive the deep-seated sources of greater good which lie latent in increased fundamental knowledge. The idea that immediate personal gain is always the greatest good, and that money is essentially more valuable and a greater source of happiness than knowledge, are only worthy of the darker ages; the greater good, however, takes a longer time to grow. Great good *must* come from new truth, even when we cannot see the way; new facts are the origin of human progress, and great truths are the parents of great uses; there can be no inventions without the facts upon which to base them, and the progress of mankind is greater in proportion as the facts discovered are more comprehensive; for instance, out of the simple qualitative fundamental fact of magneto-electric induction has arisen the dynamo-electric machine and all its world-wide uses. Other similar examples might easily be adduced.—*Chem. News.*

THE COPPER MINES OF SPAIN.

THE British Vice Consul at Huelva, in his trade report for the past year, says that the great strides in prosperity made by the province of Huelva during the last twenty-five years are due to the scientific development of its enormous mineral wealth. It is not, however, the first time that that mining district has been the scene of great activity, for the large masses of ore in its mountains furnished quantities of highly-prized metal to the old nations of the Mediterranean. According to history and tradition, the Phenicians were the first known people to work the Huelva mines, remains of their workings, ovens, coins, and other articles having been found in most of the mines. After the Phenicians came the Romans, and during their dominion in Spain mining operations were greatly extended, as is proved by the great amount of scoriæ to be found in every mine. This is calculated to be in all 20,000,000 to 25,000,000 tons, showing that immense quantities of ore must have been extracted during the centuries of Phenician and Roman work, until it ceased with the invasion of the Vandals. It is not apparent that either the Goths or Moors worked the Huelva mines, so that they have practically been idle for fourteen centuries, for the little that was done during the last and first half of this century can hardly be taken into account. The first great impulse was given by the foundation, between 1866 and 1875, of large foreign companies. The mines began to be thoroughly opened out, railways were constructed to the port of Huelva, and magnificent shipping piers were built in the river. Other companies then followed, and a period of great activity set in, completely altering the aspect of the province and of the port. The copper pyrites, or cupreous sulphur ore, composed of about 48 per cent. sulphur, 44 per cent. iron and 3 per cent. copper, is the principal ore mined in the district, and contributes very considerably to the copper production of the world. By far the greater part is sent to Great Britain, although large quantities are sent to Holland and Germany; France and the United States are also consumers, and a small quantity goes to Denmark. British vessels convey nearly all the copper pyrites, but a good many cargoes have been shipped to Germany in German steamers. The pyrites sent to the United States is of the poorer class, containing about 1·35 per cent. of copper only on the average, and is shipped principally to Philadelphia and New York. The ore is also partly treated at Huelva by smelting, which produces the regulus, containing about 30 to 40 per cent. of copper, and by precipitation on to pig iron in large tanks, giving cascard or precipitate with 60 to 95 per cent. of copper, according to treatment. The iron pyrites is what is called pure—that is to say, it contains 44 per cent. of iron and 52 per cent. of sulphur, but no copper, and it is extracted from one mine only. Besides the considerable quantities shipped to Great Britain, there is a large consumption in France, Germany, and the United States; it is, as a rule, friable and not hard and compact like copper pyrites.

DICKSONIAS.

THE fine examples of these plants which are to be seen at the Earl's Court exhibition recall to mind the splendid specimens that were shown at the last international show. Tree ferns now, for some reason, have lost their fascination. I am told that the fine plants that used to exist near Dublin, in Mr. Bewley's garden, have disappeared too. This is a great pity. A large trade was at one time done with the antipodes in tree ferns. The safest and surest way of getting them home alive was in the ships that came home laden with wool, and I have bought several hundreds at various times so brought home. From inquiries that have been made of me from time to time I am inclined to think these plants will again be in demand. The best size in which to import these stems is from 4 ft. to 6 ft. in height. These should be straight and sound, so that when potted they have no holes in their sides needing patching up, which I have heard many people advocate being done with Sphagnum moss. This should never be resorted to, for it makes a faulty and rotten stem at the best. These plants when brought home in a dry state should have their stems well soaked without letting a drop get into the crown, and they should be let stand in a shed or shady part of the conservatory or greenhouse, keeping the stems sprinkled; here they will soon begin to push roots. Upon the first signs of movement the plants should be potted, using fair-sized pots, which should be well drained. The best soil to pot them is in equal parts of good fibrous loam and peat, making the whole tolerably sandy. The stems should be potted very firmly, and they may be stood in a shady place in a house until their crowns have developed. The stems must be kept well sprinkled, but none should be given the crowns until they begin to push up fronds. I do not like the system of placing these plants in the stove to force their growth. Of course, I here allude to the greenhouse kinds, as those from warm regions differ in their requirements. When the fronds begin to grow, the atmosphere must be kept moist, and the plants should be syringed gently overhead at least twice in the day, morning and evening, and an occasional dewing in the middle of the day will do them no harm if the sun does not shine upon them. This will prevent the thrips gaining a lodgment on them. The following are the best known kinds:

D. Arborescens.—This is a rare plant in cultivation, and it has always been so. I have frequently in years gone by had branched stems and plain ones introduced, but never got them to live, and I am inclined to think it was from keeping them too warm. This plant is found peculiar to the island of St. Helena, where it grows from 6 ft. to 18 ft. high, the crown densely clothed with long amber-colored silky hairs; the fronds attain a length of 6 ft. It was upon this species the genus was founded, and I cannot agree with those authors who join with these arborescent kinds such plants as the Denstædtias, which have creeping rhizomes.

D. Antarctica.—This is the commonest tree fern in this country, and certainly the most useful. I have no doubt that in many parts of Ireland and in the west of Scotland and England it would succeed if suitable protection was afforded it. In the indoor cool fernery it forms a magnificent object. The fronds are beautifully arched, dark green on the upper side, paler beneath, the crown furnished with ferruginous hairs. Native of Australia.

D. Fibrosa is said by many to be the New Zealand form of the last named species, but under cultivation there are slight differences—the stem is always shorter and the fronds have a rigid appearance, which the true D. antarctica has not. It is neither so effective nor so beautiful as the last-named plant, but it may be grown in a collection with much advantage.

D. Squarrosa.—This is the Table top Fern. The stems are slender and black, the fronds being very rigid and deep green on the upper side, paler below. It is a very handsome species from New Zealand.

Besides the above there are D. Berteroana from Juan Fernandez, and D. Sellowiana from South Brazil. Both these species, I believe, I have seen in the nurseries of Messrs. Veitch, of Chelsea. There are one or two others which I have only seen in a small state and cannot say much of, but they certainly are worth

DICKSONIA ANTARCTICA.

seeking for and adding to a collection. They are D. Deplanchei from New Caledonia, D. lanata from New Zealand, D. Youngiæ from New South Wales, and D. Brackenridgei from the island of Samoa. The last I have not seen, but I am told it is very near to D. Berteroana.—*Wm. Hugh Gower, The Garden.*

SPONTANEOUS CONVERSION OF ISOPRENE INTO CAOUTCHOUC.*

By WILLIAM A. TILDEN, D.Sc., F.R.S.

ISOPRENE is a hydrocarbon which was discovered by Greville Williams many years ago among the products of the destructive distillation of India rubber. Later, in 1884 (*Trans. Chem. Soc.*, xlv., 410), it was observed by myself among the more volatile compounds obtained by the action of a moderate heat upon oil of turpentine and other terpenes. It is a very volatile liquid, boiling at about 36°. Its molecular formula is C_5H_8, and it forms a tetrabromide, $C_5H_8Br_4$, but no metallic derivatives, like the true homologues of acetylene.

Bouchardat (*Comptes Rendus*, lxxxvii., 654, and lxxxix., 361 and 1117) observed that when isoprene is heated to a temperature near 300°, it gradually polymerizes into a terpene which he called di-isoprene, but which is now usually called *dipentene*. This compound boils at 176°. A quantity of colophene similar to that which is produced by the action of heat upon turpentine is formed at the same time.

When isoprene is brought into contact with strong acids, aqueous hydrochloric acid for example, it is converted into a tough elastic solid, which has been examined by G. Bouchardat and by myself; it appears to be true India rubber.

Specimens of isoprene were made from several terpenes in the course of my work on those compounds, and some of them I have preserved. I was surprised a few weeks ago at finding the contents of the bottles containing isoprene from turpentine entirely changed in appearance. In place of a limpid colorless liquid the bottle contained a dense sirup, in which was floating several large masses of solid of a yellowish color. Upon examination this turned out to be India rubber. The change of isoprene by spontaneous polymerization has not to my knowledge been observed before. I can only account for it by the hypothesis that a small quantity of acetic or formic acid had been produced by the oxidizing action of the air, and that the presence of this compound had been the means of transforming the rest. The liquid was acid to test paper, and yielded a small portion of unchanged isoprene.

The artificial India rubber, like natural rubber, appears to consist of two substances, one of which is more soluble in benzene or in carbon bisulphide than the other. A solution of the artificial rubber in benzene leaves on evaporation a residue which agrees in all characters with a similar preparation from Para rubber. The artificial rubber unites with sulphur in the same way as ordinary rubber, forming a tough elastic compound.

The constitutional formula of isoprene is not known with certainty, but it must be selected from the five following formulæ:

$CH_3CH_2CH = C = CH_2$ $CH_3CH = C = CHCH_3$ $(CH_3)_2C = C = CH_2$	Derivatives of allene, $CH_2 = C = CH_2$.
$CH_2CH = CH - CH = CH_2$ $CH_2 = CCH_3 - CH = CH_2$	Derived from crotonylene $CH_3 = CH - CH = CH_2$

It is obvious that compounds such as these containing doubly linked carbon may polymerize in a variety of ways, and in the present condition of our knowledge of the constitution even of isoprene, it would be idle to speculate as to which out of the numerous possible arrangements would correspond to the constitution of caoutchouc.

* Paper read before the Philosophical Society of Birmingham, May 18, 1892.—*Chem. News.*

THE CONSTITUENTS OF EUCALYPTUS OILS.

By H. HELBING and Dr. F. W. PASSMORE.

THE conflicting statements that are continually made concerning eucalyptus oils, especially those employed for medicinal purposes, render it desirable the principal points in their chemical composition should be clearly indicated, as far as known, in order to avoid confusion, and also to place one in position to judge for himself of the veracity or falsehood of statements that are constantly published, not only concerning eucalyptus, but other essential oils that come into universal use.

Although it cannot be denied that the publication of misleading representations has greatly retarded the progress of knowledge concerning the chemistry of essential oils, the subject is undoubtedly one that has taxed to the utmost the skill of experienced investigators, and it is no discredit that older chemists were unable to accomplish a task that has only been rendered practicable by the resources of the modern laboratory. The enormous amount of literature that characterizes the subject is sufficient evidence of the labor that has been expended in such investigation; but the greater part of the results were rendered invalid through the inability of the investigators to obtain either pure products or characteristic derivatives of the compounds entering into the composition of essential oils. Exceptions must be made in favor of the researches of Berthellot, Tilden, Gladstone, Armstrong and a few others, but even these, valuable as they are, were of so isolated and disconnected a character they did not greatly aid in extension of general knowledge.

The merit of having first introduced a systematic course of investigations into this dark chapter of chemistry, and the satisfaction of seeing valuable fruits from the enterprise and stimulus given to further research in the same direction, must be accredited to Wallach, with whose name is associated a host of others whom he inculcated with his ideas and methods. It is therefore obvious that a consideration of the chemistry of the constituents of the essential oils in general would practically involve little more than a recapitulation of Wallach's researches during the last decade, and as this has been so recently and admirably done by Wallach himself in an address delivered before the Berlin Chemical Society (February, 1891), we shall only attempt to deal with those facts that have direct bearing on the chemistry of eucalyptus oils.

TERPENES.

Like all essential oils, those from the different species of eucalyptus contain varying quantities of terpenes. The terpenes, as may be recognized from the termination "ene," are hydrocarbons, and although generally reckoned among the aromatic series, present certain peculiarities that distinguish them from ordinary aromatic hydrocarbons, although their molecules are undoubtedly correctly represented by the ring structure. These differences are very apparent from their unstable nature and the readiness with which they are convertible one into another, or into bodies of allied composition, by the influence of chemical reagents, or by physical conditions.

This instability has been the chief difficulty necessary to overcome in securing in condition of purity for purposes of characterization and comparison, for so readily are the changes effected, and so closely do many of the terpenes approximate each other in physical characteristics and behavior toward chemical reagents, that it has been frequently found what was regarded as a definite compound was but a mixture, and that the supposed process of purification had effected the decomposition of the original substance. In consequence, nearly every fresh investigation of essential oils at one time led to the fancied discovery of a new terpene that differed in some minor detail from any that had been previously isolated; thus the number of terpenes appeared to be "legion."

Systematic research has now, however, reduced the number of terpenes proper (that is to say, those represented by the formula $C_{10}H_{16}$, which are recognizable by some specific chemical test) to about nine or ten, although all these have not yet been obtained in an absolutely pure state, and consequently the identity and nomenclature of some have been disputed. There is little doubt, however, that at least nine isomerides do exist, and possibly more, but experience has taught the existence of new terpenes should only be accredited when very distinct and corroborative proofs are forthcoming. But besides the true terpenes there is a far larger class, mostly polymerides of the substances represented by the formula $C_{10}H_{16}$, which are also included under the general appellation of ter-

penes, the extreme limits of which are reached in colophony and caoutchouc.

The terpenes that have been recognized as constituents of the eucalyptus oils are, however, three or four of the best known, viz., pinene, phellandrene, limonene and possibly dipentene; all occur in connection with polyterpenes of highest boiling point and greatest specific gravity, which at present have been little investigated, and may be either original constituents or only produced by the process of resinification, which, to certain extent, obtains to any and all essential oils during distillation and storage, especially when exposed to the influence of light and air.

Pinene, phellandrene and limonene are capable of existing in two optical modifications; that is to say, they are capable of rotating a ray of polarized light, either to the left or right, owing to the presence of an asymmetrical carbon atom in their molecules, around which the other atoms tend to revolve in either a lævogyre or dextrogyre direction, and so produce the twisting of the ray observed. Dipentene in some respects bears the same relation to dextro and lævo-limonene as does inactive tartaric acid to the two active modifications of this acid. It is inactive, and both limonene and pinene are convertible into it at high temperatures, as well as by the action of acids, while it also results from the decomposition of some of the oxygenated terpene derivatives, like eucalyptol. Although pinene, phellandrene and limonene are all capable of existing in two optically active modifications (as well as in the apparently inactive form, consisting of an equal mixture of the two active forms), only one or the other of these modifications occurs in the eucalyptus oils. Dextropinene and lævo-phellandrene are always met with, while so far as our experience serves, the limonene of eucalyptus oils is also of a lævo-rotatory character.

Although the physical and chemical characteristics of the terpenes more commonly met with are now definitely determined, the nature of the chemical tests, while furnishing unmistakable results with the pure substance, requires they shall be applied with the utmost care and skillful manipulation, in order to obtain positive proof of the presence of a terpene. Pinene boils at 160° C., and has a specific gravity 0·858 at 20° C.; phellandrene boils at about 170° C.; while limonene and dipentene boil at 175° C., and possess the specific gravity 0·846 at 20° C. It is evident, therefore, that the boiling points of these isomerides are too near to permit of very satisfactory separation by fractional distillation, though it may be observed that those eucalyptus oils containing much pinene commence to distill at a lower temperature than oils that are completely free from it—supposing the other constituents are the same—while the first fractions, and generally the oil itself, have a dextro-rotatory action.

In the examination of oils for medicinal purposes, whether distilled from *Eucalyptus globulus* or any of the Mallee species so rich in eucalyptol, the popular impression that such oils should have a lævo-rotatory action appears to possess some warranty, from the fact the lower boiling fractions containing pinene have been removed, and the percentage of eucalyptol, which boils at about the same temperature as limonene and constitutes the active principle of the oil, has been consequently increased in the selected distillate. It will be seen upon consideration, however, that very much depends on the manner in which the distillation is conducted, and upon the proportion of other constituents in the oil, as to which fraction will contain the most eucalyptol; and consequently, if the distillation has been intelligently conducted, this factor will also determine the rotatory power of the distillate. As a matter of fact, although the majority of oils that we have examined exhibited a lævo-rotatory action, yet extremely good oils containing a large amount of eucalyptol have been met with, that possess a dextro-rotatory action; but in all cases the optical activity of good oils has been found comparatively low, as might be expected when the largest constituent is itself inactive.

Pinene and limonene may be recognized by their respective compounds with bromine, and also with hydrochloric and hydrobromic acids. If anhydrous hydrochloric acid gas be led into an absolutely dry solution of pinene in petroleum ether that is kept well cooled, one molecule of hydrochloric acid is absorbed, and a solid hydrochloride, $C_{10}H_{16}HCl$, separates, that melts at 125° and boils at 207° C., which, on account of its camphoraceous odor, has been called artificial camphor.

Limonene, under the same condition, also yields a hydrochloride of the same formula, which is, however, a liquid that boils undecomposed only under reduced pressure. If water be present during the reaction, however, further changes take place, and, as with pinene and dipentene, dihydrochloride of dipentene, $C_{10}H_{16}2HCl$, is obtained; this compound crystallizes out from solutions of the terpenes in moist solvents, like ordinary ether or glacial acetic acid when hydrochloric acid is added, and forms a solid melting at 50° C., boiling under 11 mm. pressure at 115° C.

The bromine compounds afford a still better means of distinction between these hydrocarbons, as pinene only combines with one molecule of halogen to form the dibromide, $C_{10}H_{16}Br_2$, melting at 170° C., while dipentene and limonene both add two molecules of bromine, yielding tetrabromine of the formula $C_{10}H_{16}Br_4$, melting at 104° C. and 124° C. respectively. Other very characteristic compounds of the terpenes are also formed with nitrosyl-chloride, and also by the subsequent reaction of the resulting compounds with aromatic amines; but these bodies are more suited to the study of the chemical constitution of the terpenes than for purposes of recognition and identification.

Phellandrene is perhaps the easiest of all the terpenes to identify, as it forms a very characteristic compound with nitrous acid—phellandrene nitrite, $C_{10}H_{16}N_2O_3$. When the solution of phellandrene in ligroin or an oil containing phellandrene is treated with concentrated solution of sodium nitrite and then a few drops of glacial acetic acid added, very voluminous crystals of phellandrene nitrite speedily form, that when purified by recrystallization from chloroform and methyl-alcohol melt at 104° C.

Ample means are therefore placed at the disposal of the analyst for arriving at definite conclusions with regard to the qualitative composition of the terpene hydrocarbons of eucalyptus oils; nevertheless, it will be difficult to arrive at more than an approximate idea of the respective amounts. As the terpenes practically all have the same value as diluents and conservatives of other constituents of the oils, this defect is immaterial, since the replacement of one by the other only slightly affects specific gravity and volatility of the oil—perhaps its odor. It is said that phellandrene was first discovered in eucalyptus oil by Gildermeister, and found to be a notable constituent of oil of *Eucalyptus amygdalina*; further, that it possesses special medicinal value; but without definite evidence, it can scarcely be accepted that one terpene differs much from its isomerides in this respect. Undoubtedly all the terpenes possess some antiseptic and invigorating properties that may render them useful as inhalants and deodorizers, but if the principal virtues of eucalyptus oils are to be attributed to these constituents, it would be more practical and economical to employ turpentine at once. It is, however, among the oxygenated carbon compounds that will be found the chief active principles of the medicinal oils, as well as the odoriferous principle of the perfume oils.

CAMPHORS.

Eucalyptol, the stearoptene of the eucalyptus oils, is the constituent on which the eucalyptus products depend for their medical value, hence it is obvious a large percentage is regarded as a *sine qua non*. There are in market eucalyptus oils that contain 40, 50 and even higher per cent. of eucalyptol, yet claims made in this respect must be received with great caution, owing to the loose manner in which the term *eucalyptol* is applied. The pure chemical eucalyptol, which is identical with *cineol* and *cajeputol* (the latter constituents of *oleum cinae* and *ol. cajeputi* respectively) is a solid at −1° C. and boils at 176° C.; it has a specific gravity of 0·923 at 16° C.; is optically active, and possesses a specific refactory power R. = 1·45839

Eucalyptol, $C_{10}H_{18}O$, has some points in common with camphor, $C_{10}H_{16}O$, and resembles the latter somewhat in odor, but it is not for this reason that it bears the terminal "*ol*," as is sometimes suggested. "*Ol*" in chemical nomenclature is now generally recognized as the suffix peculiar to alcohol, and was no doubt given to eucalyptol in the first instance because the oxygen atom in it was thought to be combined in the form of a hydroxyl group, whereas it has lately been shown that it occupies a very curious position as a connecting link between two carbon atoms, which cause it to behave in some respects like a hydrocarbon. As eucalyptol is not an alcohol, the suffix "*ol*" is incorrect in strict significance, and hence it has been proposed to alter to "*ole*," and as a result, in many new text-books of chemistry, eucalypt*ole* or cine*ole* will be frequently found replacing eucalyptol and cineol.

The estimation of eucalyptol in essential oils may be effected by more than one method. The most simple, and in our experience the most reliable under certain conditions, is crytallization out of the oil at low temperatures. The oils richest in this constituent, such as the "mallee," will frequently become almost solid when placed in a mixture of ice and salt, but in poorer oils greater difficulty is experienced in effecting the separation, for since such necessarily contain more terpenes, which latter act as solvents of eucalyptol and prevent its crystallization, such an oil must be cooled considerably below the solidifying point of eucalyptol in order to insure separation of the latter, and if much terpene is present even a temperature of −16° to −18° C. is not sufficient. Here concentration must first be effected by submitting the oil to fractional distillation and collecting the fractions (boiling within several degrees of the boiling point of eucalyptol, for example, between 172° and 180° C.), from which the stearoptene may then be removed by refrigeration, and the liquid filtrate, if necessary, again redistilled and refrozen. Very good and constant results can be obtained in this manner with most eucalyptus oils, but it is necessary the crystallizable substance thus obtained be carefully examined, and its physical and chemical character determined positively to be those of eucalyptol ere it is decided to be such.

Other methods for the isolation of eucalyptol are based on the preparation of its compounds with halogen and halogen acids. The formation of the bromine addition product, $C_{10}H_{18}OBr_2$, is a very characteristic reaction, and the rapid separation of a crust of red crystals when bromine vapors are allowed to pass over a film of eucalyptol affords a very useful and reliable test.

The preparation of the hydrochloride is also comparatively easy, since on passing a current of dry hydrochloric acid into a solution of eucalyptol in ligroin, or into a eucalyptus oil diluted with ligroin, which must be kept well cooled, the whole of the eucalyptol is precipitated in the form of a crystallized hydrochloride, $C_{10}H_{18}OHCl$. This would, therefore, form a very ready method for estimation of eucalyptol in eucalyptus oils, but for the unfortunate fact eucalyptol is not the only substance occurring in eucalyptus oils that can be precipitated under the above conditions; and again, if the conditions as to temperature and freedom from moisture are not strictly adhered to, the eucalyptol will be decomposed and dipentene dihydrochloride formed. To obtain trustworthy results, it would, then, be necessary to regenerate the original substance from the precipitate by removal of the hydrochloric acid with anilin or sodium acetate, and to examine the product obtained.

In some oils, notably that distilled from *E. amygdalina*, neither the refrigeration nor hydrochloric acid method yields evidence of the presence of eucalyptol, which, although contained in the oil, is extremely difficult to separate on account of the extraordinary solvent action of some other constituent, possibly phellandrene. Its isolation was first effected from such oils in the form of the hydrobromate, by a process analogous to that employed in preparing the hydrochloride; and, like the latter, it is very hygroscopic, when pure melting at 56–57° C.

A final method that may be employed is the formation of cineolic acid by oxidation with potassium permanganate, but the process is rather tedious and requires an excessive amount of material. Cineolic acid melts at 196° C., and passes over in an anhydride form.

Recently it has been claimed that terpene hydrate was to be found to the extent of 2 or 3 per cent. in commercial eucalyptus oils, and obtained in large glistening crystals melting at 115° C., of the composition $C_{10}H_{20}O_2$, H_2O. The discovery, if true, is the more interesting because terpene hydrate also gives crystals when heated with gaseous hydrochloric acid, which might easily be confounded with those obtained from eucalyptol; therefore is further manifested the importance, already emphasized, of careful examination of the product obtained by any of the methods recommended for the separation of eucalyptol, ere its character is definitely pronounced upon.

ALDEHYDES AND KETONES.

It is no doubt to these and to the class of bodies known as alcohols and esters that the eucalyptus oils derived from different species acquire their distinctive odors, although in the medicinal oils they exist in mere traces. Aldehydes and ketones may be easily recognized and isolated from other constituents by means of their characteristic compounds with sodium bisulphite. On shaking the oils with a concentrated aqueous solution of this salt, the aldehydic and ketonic compounds crystallize out and can be readily removed by filtration, washed with ligroin, and the original substance obtained by treatment of the bisulphite compound with dilute acids or alkalies, shaking the resulting solution with ether or some similar solvent.

Thus far little has been done in the way of determining the chemical composition and constitution of these bodies, although some of the perfume oils, as *Eucalyptus maculata* var. *citriodora*, contain large quantities. Citral, $C_{10}H_{18}O$, is the aldehyde which is best known, and besides being found in the higher boiling fractions (about 220° to 240°) of several eucalyptus oils, forms an important constituent of citron oil, to which it communicates its peculiar aroma.

The investigations of Semmler have established the near relation of citral to constituents of other perfume oils and also to the hydrocarbon cymene; in fact, by the oxidation of geraniol (occurring in geranium oil) with chromic acid, citral is obtained, and by further oxidation with oxide of silver, geranic acid, so that geraniol and citral and geranic acid stand in the simple relation to each other of primary alcohol, aldehyde and acid.

Another aldehydic or ketonic constituent of eucalyptus oils (notably of *E. dealbata* and *E. maculata*) that has attracted some attention is citronallon, also an important constituent of citronella oil.

Still another class of aldehydes sometimes met with in inferior eucalyptus oils are a serious source of danger if intended for inhalation or other medicinal purposes, since they possess properties like those of the lower aldehydes of the fatty series, and therefore irritate the mucous membrane of throat and lungs, inducing cough.

As eucalyptus oil is recommended in the treatment of tuberculosis, diphtheria and other throat and lung affections, too great stress cannot be laid upon the presence of even traces of these bodies. They distill over with the first fractions of the oil, and may be easily recognized in them by means of the bisulphite test. Whether these compounds are natural constituents, or whether they are produced by careless distillation and decomposition of other substances, is at present an open question; but it should be borne in mind that oils that are not carefully distilled are known to acquire a "retort" odor, while the dry distillation of various organic substances yields formic aldehyde and acrolein among their decomposition products.

ALCOHOLS AND ESTERS.

Among the higher boiling fractions of eucalyptus oils, small quantities of esters, compounds of organic acids with alcohols, have been recognized, but little information is available with respect to the extent of their occurrence or their nature. They may, however, be investigated as regards their acidic constituents, by saponifying the oils with alcoholic potash at the temperature of the water bath, and examining the alkaline liquors for organic salts by acidifying and extracting the acid. In this way the presence of acetic and butyric acids may be recognized, which in the form of their esters no doubt contribute to determine the aroma of their respective oils.—*Bulletin of Pharmacy, London, England.*

TESTING BEESWAX FOR ADULTERANTS.

By C. SHERRAD.

FEW articles of commerce, as extensively used, are more susceptible to easy and successful sophistication than beeswax. This is especially true when paraffin or ceresin, or both, is made the adulterant. Other adulterants, as water, kaolin, starch, flour, resins, fatty bodies, gypsum, etc., were not considered in the tests made, from the fact that they are rarely or seldom employed for the purpose named. Various methods for the detection of paraffin and ceresin have been suggested and applied, most prominent of which is the one given by Allen in his Commercial Organic Analysis.

The results obtained by the application of the sulphuric acid test, as detailed by Allen, led to some doubt as to its reliability in two particulars; the first being the possibility of failure to decompose all the beeswax at the temperature and in the time specified.

Second, this being true, whether or not some of the paraffin or ceresin might not be destroyed under the conditions which insured the complete decomposition of the beeswax.

The sulphuric acid test is carried out by heating five grammes of the sample to 130° C. in a capacious flask with 50 c. c. of concentrated sulphuric acid. Charring takes place, and sulphur dioxide and other gases are evolved, causing the fluid to froth considerably. After about ten minutes the mixture becomes almost solid, when it is allowed to cool, the acid removed by washing with water and the residue treated with a little cold alcohol to remove adhering water. The filter containing the black residue is then exhausted with hot ether, preferably in a Soxhlet's tube, when the ether yields the hydrocarbon wax on evaporation. It should be weighed and then again treated with sulphuric acid and the residue exhausted with ether as before, as a little beeswax is liable to escape decomposition during the first operation.

In applying this test it is necessary, in order to obtain as nearly a uniform temperature as possible, to stir the solution almost constantly after it has attained the temperature of 130° C. In this way the tempera-

ture is kept almost uniform throughout, or as nearly so as possible.

Without the stirring the different strata in the container would be subjected to different degrees of temperature. So that if the temperature were adjusted to 130° C. for the lower stratum, the upper would be considerably less, and so for any other adjustment there would be a lack of uniformity of temperature. Hence the necessity for the careful stirring during the heating process.

The U. S. P. test for paraffin as an adulterant consists in heating five grammes of the wax in a flask for 15 minutes with 25 grammes of sulphuric acid to 160° C. and the mixture diluted with water; no solid, wax-like body should separate.

Applying Allen's test, but extending the time to 15 minutes, observing the precautions previously mentioned, and further modifying it by finally dissolving the undecomposed wax or impurities in a given amount of chloroform and decanting an aliquot part for evaporation. [The chloroform was adopted in preference to ether, as it was found by several experiments to have in the cold a better solvent action on ceresin and paraffin than was the case with ether.] Applying this test to a sample of yellow wax known to be pure, there was found to be after the first operation 22·8 per cent. of the wax undecomposed. Repeating the operation on this residue, there still remained undecomposed 12·1 per cent.

A good grade of paraffin was then subjected to the same, with the result that, after the first treatment, there remained undecomposed 81·6 per cent., and after the second treatment 64·8 per cent. remained undecomposed. From this it will be seen that even at the temperature specified the wax is not wholly decomposed on a repetition of the process, and further that this process applied to paraffin decomposes that body to a very appreciable extent.

Consequently a pure wax will be reported adulterated, while an adulterated wax will show probably a lower percentage of adulteration than that actually present, notwithstanding the compensation which occurs by reason of the wax not being entirely decomposed. As a result of these preliminary experiments I was led to make a further trial on pure wax at higher temperatures and for a longer period of digestion, with a view of fixing the lowest temperature and time that could be employed to fully decompose the wax, and having determined that point, to then obtain some idea of the extent of carbonization of ceresin and paraffin when treated similarly.

TREATMENT OF THE WAX.

A sample of beeswax known to be pure was treated successively at 130°, 145°, and 160° C. for thirty minutes, and yielded respectively of undecomposed wax 12·7 per cent., 6·9 per cent., and 0·0 per cent.

A second sample, also fully believed to be pure, was treated exactly the same, and yielded of uncarbonized wax 12·6 per cent., 6·1 per cent., and 0·0 per cent.

TREATMENT OF PARAFFIN AND CERESIN.

A sample of paraffin treated at 130° C. for fifteen minutes yielded 8·86 per cent. of residue, showing a carbonization equal to 18·4 per cent., and when the operation was repeated there remained 64·8 per cent. of residue, showing a carbonization of 35·2 per cent.

When the same sample of paraffin was treated at 160° C. for thirty minutes the residue was only 30 per cent., thus showing that it had suffered carbonization to the surprising amount of 70 per cent. It will be remembered that this is the temperature but not the time of the pharmaceutical test.

Ceresin treated at 160° C. for thirty minutes yielded 59·3 per cent. of residue, and was therefore carbonized to the extent of 40·7 per cent.

INFLUENCE OF TEMPERATURE WITHOUT THE PRESENCE OF SULPHURIC ACID.

The question now arose as to how much the above loss was due to carbonization and how much to volatilization at the high temperature employed. To settle this point paraffin and ceresin were heated on an air bath for sixty minutes at 160° C.; the paraffin lost 9·7 per cent., while the ceresin lost but 4·5 per cent., showing that volatilization, though comparatively slight, is not wholly to be ignored.—*Chem. Tr. Jour.*

DETERMINATION OF THE SOLUBILITY OF SALTS.

By R. RUDORFF.

THE arrangement consists of a glass 4 cm. in height and 2 cm. wide at the bottom, closed with a cork having two perforations. Through the one passes a narrow glass tube open at both ends, and through the other a short glass tube expanded above the cork, over which is drawn a piece of lawn held fast by a piece of caoutchouc tubing drawn over it. The upper part of this caoutchouc tube is closed by a piece of glass rod. In order to effect a determination a solution of the salt is prepared, saturated at a higher temperature, and the beaker containing the solution is then set in a water bath of the required temperature. The observer waits until the temperature of the solution agrees with that of the water bath, the liquid is then stirred up with the apparatus, of which only the glass rod and the narrow glass tube project above its level, and the glass rod is then for a moment drawn out of the flexible tube. A few drops of the solution flow down into the glass. The flexible tube is closed again, the apparatus is lifted up out of the bath, and cleansed by rinsing and wiping. The cork is removed, the glass is closed with a ground stopper, and the solution which has entered is weighed. On determining the quantity of the dissolved body present, its solubility is found.—*Zeit. fur Angew. Chemie.*

ANHYDROUS CRYSTALLINE NICKEL AND COBALT FLUORIDES.

By C. POULENC.

THE author obtains at first the amorphous fluoride by the decomposition of the double ammonium fluoride, and then causes it to crystallize in presence of vapors of anhydrous hydrofluoric acid. This method is generally applicable and gives excellent results. Nickel fluoride, NiF_2, appears in the form of elongated prisms of a fine green. It is almost insoluble in water, and completely insoluble in alcohol and ether. It is not attacked by hydrochloric, nitric, and sulphuric acids, even if hot. Its specific gravity is 4·63. If heated in presence of air, it is converted into nickel oxide. Sulphur yields black nickel sulphide. Hydrogen reduces it at a red heat—a property which the author has utilized for the determination of nickel in the metallic state. The vapor of water decomposes it, with the production of a black oxide retaining the crystalline form of the fluoride. At higher temperatures there is formed green oxide still retaining the same form. Sulphureted hydrogen converts it at a red heat into a yellow crystalline sulphide and hydrofluoric acid. Cobalt fluoride, CoF_2, is a rose colored powder, very soluble in water. It fuses without volatilization until it reaches a temperature of 1,400°. Its form is that of small ramified prisms. It is slightly soluble in water, insoluble in alcohol and ether. Its specific gravity is 4·43. Hydrochloric, nitric, and sulphuric acids attack it slowly in the cold, but more rapidly in heat.

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